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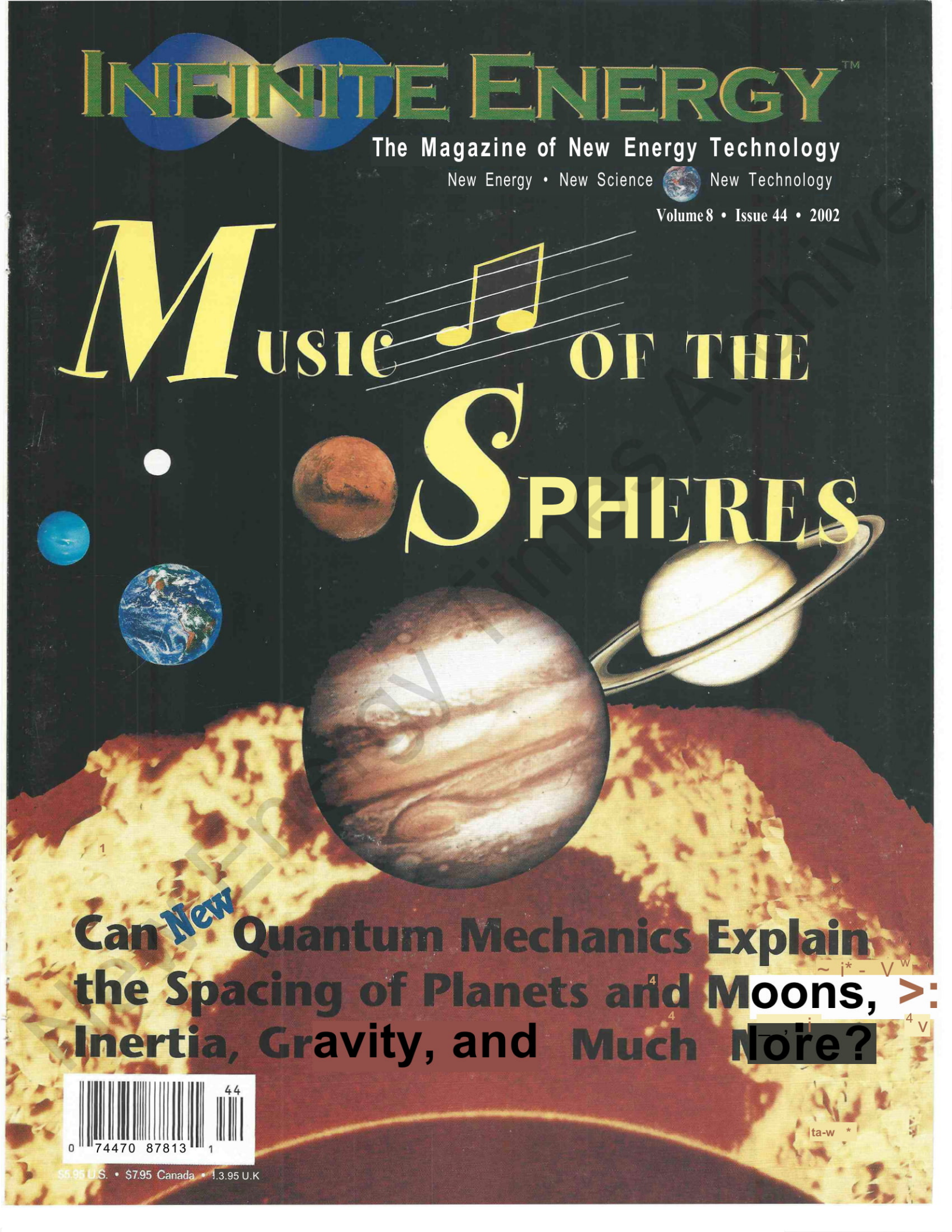

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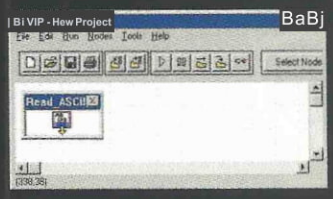

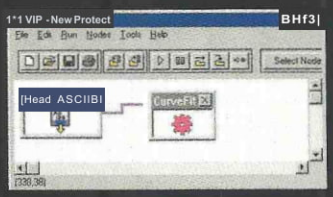

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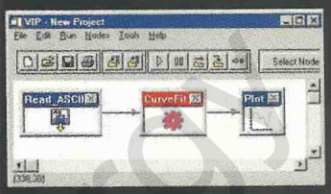

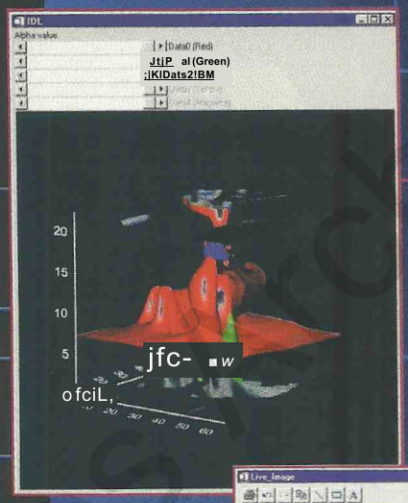

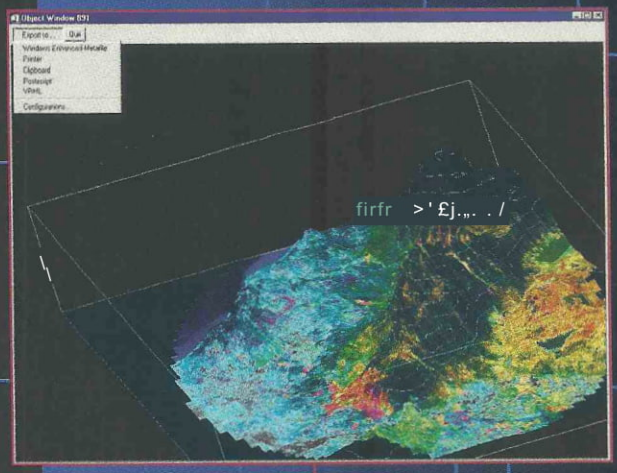

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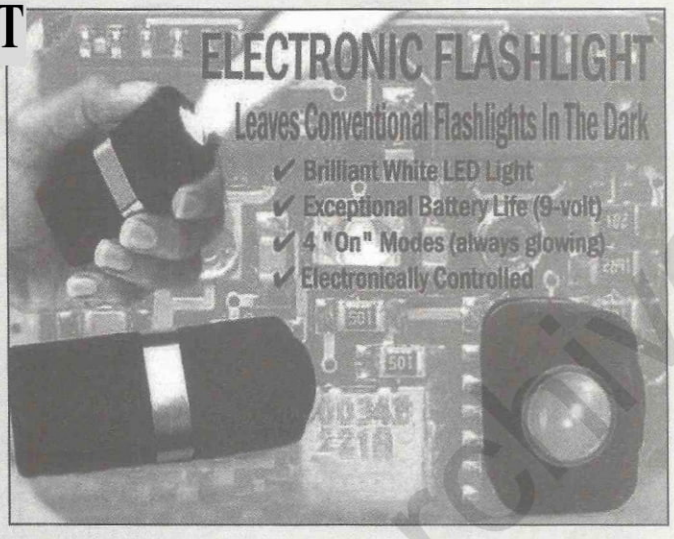

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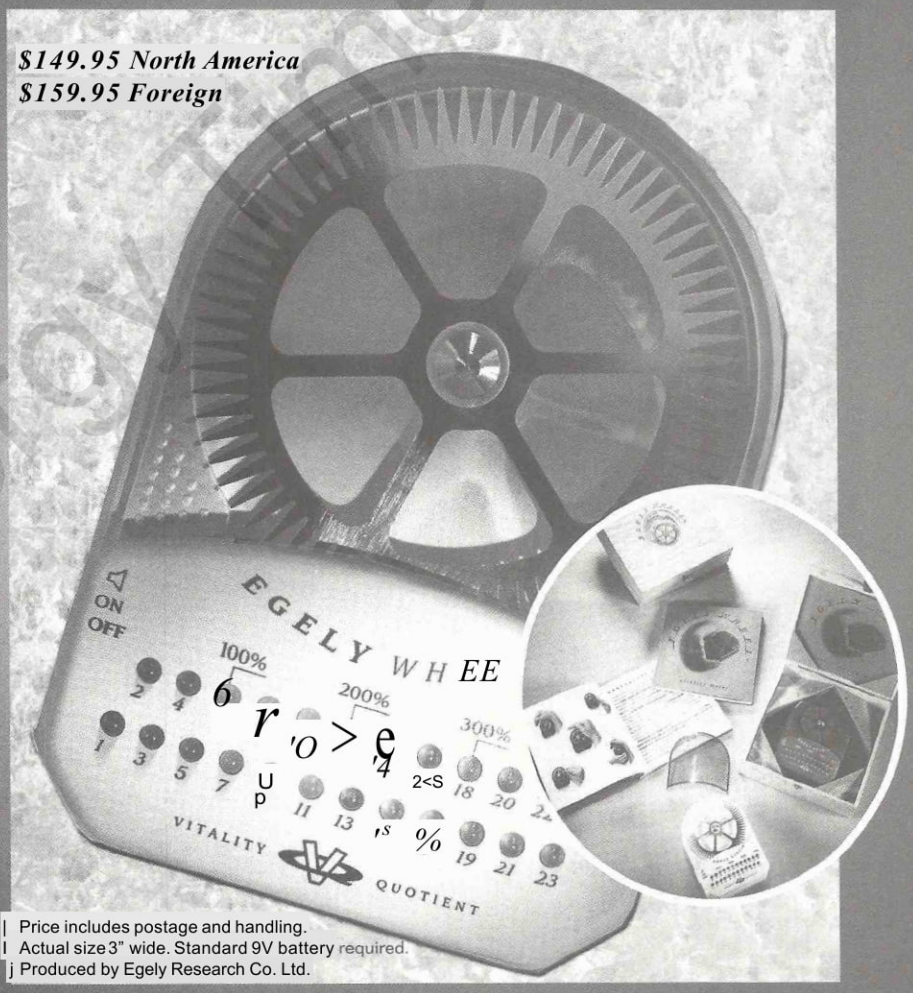

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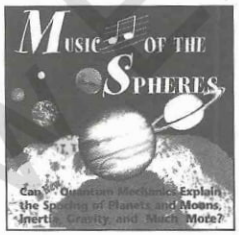

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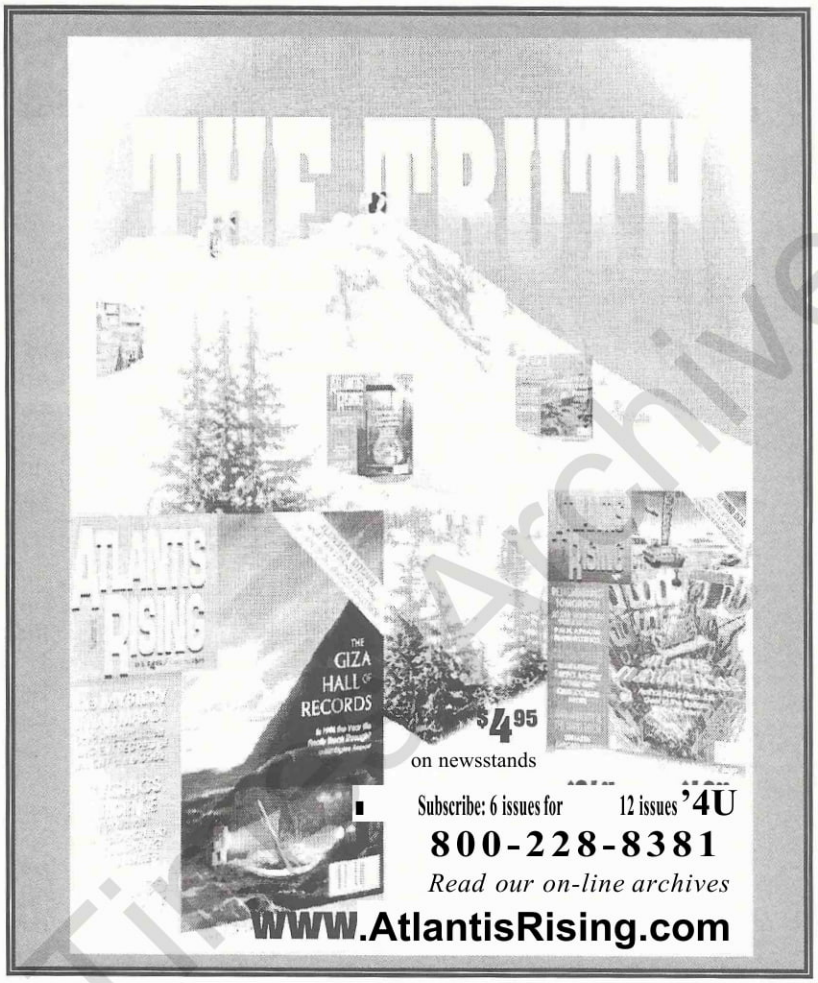

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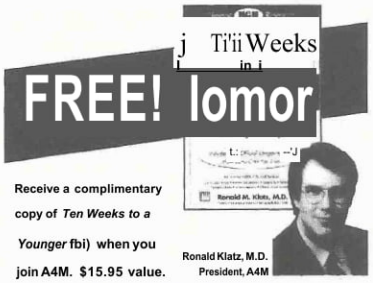

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LETTERS TO THE EDITOR

Place Your Bets

A < ark P. Mills hit a grand slam with his article in *IE* #42 IV A entitled "Getting It Wrong: Energy Forecasts and the End-of-Technology Mindset." This was an outstanding article in every respect! Because most people, especially scientists, do not understand economics, it needs to be emphasized that the choice of an energy source must be based solely on economics. Furthermore, not only is oil *not* going to get scarcer, it is very probably an *inexhaustible* source of fuel. There is good reason for this—fossil fuels are not "fossil" in origin at all; they are fundamental hydrocarbon building blocks from the Earth's original formation.[1] Microbes merely use oil as a source of fuel, leaving behind their characteristic signatures, hence the fossil misnomer. (The geologists currently have it wrong, but give them ten or twenty years and they will come around. They accepted the Pangea paradigm in less time.) Many oil wells around the world are continually refilling themselves. Oil is far, far more abundant than presently estimated, with the largest reserves in our own Gulf of Mexico.

There is no global warming—this is not just a case of bad science, it is *juvenile.* One has only to think back to the Malthusian experts who were predicting global cooling[2] in the late 1970s. (But hey, whatever it takes to extort the taxpayer's dollar for funding!) When it comes to long-term climate prediction models, engineers know better—they laugh and shake their heads. Most non-linear computer models are little better than useless. Engineers know this because they must produce—they must actually deliver the goods, unlike researchers who need only publish results, accurate or not. So engineers develop alternative approaches to get reasonable results based on the empirical data. They fit their models to the experimental data. Unfortunately, this is not possible with predictions. Would anyone care to predict the *next* scare tactic, once the global warming scare has fizzled?

I was shocked and dismayed at the vitriolic anger displayed by Jed Rothwell in his hysterical rebuttal to the Mills article (same *IE* issue). It seemed to me that Rothwell had a personal axe to grind, as all objectivity was absent. He railed about there being a grave shortage of energy in two-thirds of the world, but he didn't seem to realize that this is a direct result of government corruption. Unrestrained capitalism always works—witness the rebirth of the Russian economy. With the advent of electrical power deregulation, the cost of electricity continues to drop in my home state. There are two reasons for this. First, unlike California, the State of Texas encourages business development and free enterprise. We have a surplus of electrical energy *producers.* Second, the Texas electrical (AC) power grid does *not* connect across state lines, so the federal government cannot step in and meddle in our affairs. Cold fusion is not yet a qualified energy source, but a frontier science for exploration. Rothwell seemed agitated that there was no mention made of it by Mills, but neither did Mills mention the bottomless money pit of hot fusion. Mills was addressing proven energy sources, not laboratory experiments.

In 1990, the Malthusians lost a thousand dollar bet to the Cornucopians that the cost of five strategic metals would increase over a ten-year period.[2] (Like water, the supply of metals is, in essence, *inexhaustible.')* Perhaps Rothwell would care to put his money where his mouth is and work out a bet between himself and Mills on the future price trend and availability of oil?

Energy consumption will continue to increase both domestically and abroad, as other countries throw off their socialistic shackles.[3] The populations of the Third World will level off as they enter into an industrial-based society, just as was the case for America in the early twentieth century. Oil will continue to become cheaper and more plentiful. Optimistic predictions will always prevail over pessimistic ones.

Bill Cantrell
Rhome, Texas

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1. Gold, T. 1999. *The Deep Hot Biosphere,* Copernicus Books, New York.

2. Bailey, R. 1993. *Eco-Scam: The False Prophets of Ecological Apocalypse,* St. Martin's Press, New York.

3. Huber, **P.** 1999. *Hard-Green: Saving the Environment from the Environmentalists,* Basic Books, New York.

Jed Rothwell Responds: Yes, the choice of energy sources must be based on economics, but this is an unhelpful truism, like saying the way to make money in the stock market is to buy low and sell high. We cannot predict what sources will be economical in the future. In 1970, wind-generated electricity was far more expensive than coal. Now, it costs about the same nominally, and taking into account the damage coal causes, it is cheaper. In 2020, cold fusion fuel may be ten thousand times cheaper than oil.

The global warming hypothesis is controversial, but we should not dismiss it. The Earth's climate is growing warmer at an alarming rate. Perhaps this is a coincidence and the trend will soon pass. Perhaps some force of nature is causing it, and man is not to blame. But it would be foolish to deny man's awesome power over nature. Man has changed the face of the Earth. He has made deserts out of fertile land and exterminated species.

Capitalism is good, but not good enough yet. Even in the U.S., thousands of people cannot afford enough energy. Smog from coal and oil kills tens of thousands of people, and makes millions of others miserable. We can do better. We must not be complacent, or satisfied with dangerous technology. Cautious optimism is laudable. Panglossian naivete and over-confidence are not. History teaches that optimistic predictions do not always prevail over pessimistic ones! Countless businesses have failed. Promising breakthroughs have turned out to be too expensive, dangerous, or impractical.

jfy

The Planetary Solution

Tnfinite Energy continues to remind the world that our attitudes *J.* and prejudices are the greatest hindrance to innovation. Any solution to our energy problem must be a planetary one!

Gregory Alan Todd
Colorado Springs, Colorado

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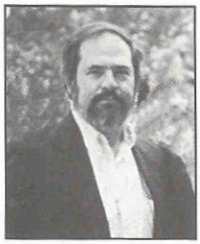
The Boundaries of Cold Fusion

by Eugene F. Mallove, Sc.D.



Quote: "We do not know if Cold Fusion will be the answer to future energy needs, but we do know the existence of Cold Fusion phenomenon through repeated observations by scientists throughout the world. It is time that this phenomenon be investigated so that we can reap whatever benefits accrue from additional scientific understanding. It is time for government funding organizations to invest in this research."

So wrote Dr. Frank E. Gordon, Head, Navigation and Applied Sciences Department Space and Naval Warfare Systems Center, San Diego, in introducing a just released official U.S. Navy Report, TECHNICAL REPORT 1862, February 2002, *Thermal and Nuclear Aspects of the Pd/D_2O System, Volume 1: A Decade of Research at Navy Laboratories; Volume 2: Simulation of the Electrochemical Cell (ICARUS) Calorimetry.* (See p. 54 of this issue to learn more about the content of this report.)

Cold fusion pioneer Dr. Martin Fleischmann is one of the report's co-authors, a modest acknowledgement of the importance of his work by at least one official U.S. organization. But this is far short of the high-level apology that is due this scientist for the inexcusable malfeasance of the DOE "Cold Fusion Panel" in the 1989 trashing of his work. Across the pond in the U.K., by now Martin should have become Sir Martin Fleischmann. How unjust that his work is not honored even in his own land, while Mick Jagger of the Rolling Stones will soon be Knighted! (Please excuse me while I have my " nineteenth nervous breakdown.")

Don't expect that the Navy report will move the U.S. government one millimeter closer toward re-evaluating cold fusion. In fact, one bigoted anti-cold fusion scientist within the U.S. government (Dr. Peter Zimmerman, for a time a "scientific advisor" to the U.S. State Department) after hearing about the report *(but without having read if)* exclaimed on an Internet forum (May 9): "It's my contention that somehow the crap in it [the Navy Report] did not go thru the formal NRL review process which is very, very rigorous. I want to know why the Navy issued it." He promised immediate action to cause trouble within the bureaucracy. As has been happening for over thirteen years, no sooner does a positive development arise for cold fusion, but influential negativists go to work to make sure that no change is made in the government's disgraceful non-policy.

So the study of low-energy nuclear reactions (LENR, the more generic term for the plethora of cold fusion-related discoveries) in the U.S. is bounded on one side by active obstruction by government agencies. This, in turn, has made it nearly impossible to raise R&D capital from the private sector for investigations that are considered foolish by officialdom.

The tight financial boundaries of cold fusion have made it an island kingdom with diminishing resources. I have just returned from the Ninth International Conference on Cold Fusion (ICCF9), which was held in Beijing (May 19-24) with official support by Chinese scientific organizations. As our initial report remarks (see p. 8), the human capital of cold fusion is aging and is not being renewed by a healthy influx of younger researchers. This is not surprising for a field that is so widely devalued; the career risks for becoming involved—even should some young researcher develop an interest—are just too great.

On the scientific front on the other hand, it not easy to find a field that has opened wide more of Nature's doors than cold fusion. As reports at ICCF9 and at many other recent LENR conferences suggest, "cold fusion" has become squarely the field of "modern alchemy." The transmutation of heavy elements in these experiments has become the order of the day. Mitsubishi Heavy Industries sends its researchers to Beijing to report the repeatable, *on demand* transmutation of cesium to praseodymium and strontium to molybdenum (see p. 10)! This work will soon be published in the *Japanese Journal of Applied Physics.* This too will be ignored by mainstream physics, but what a spectacular achievement!

It has taken far too many cold fusion researchers much too long to realize that heavy element transmutation is integral to what they are studying. In the early 1990s cold fusion began to show strong symptoms of this alchemical direction. Yet it has taken *some* cold fusion researchers over a decade to finally acknowledge the reality of the low-energy nuclear transmutation of heavy elements.

This brings up the compelling scientific question: *What are the scientific boundaries of cold fusion?* We're no longer talking about the now obsolete question of 1989: Is it chemistry or physics? We now need to know where cold fusion fits *within* physics such that a profusion of alchemical results should be coming forth. Why is it so damned simple to create element changes in low-energy experiments? This just has to be a significant clue to the nature of cold fusion physics, but it may not lead to an answer that many in the field will appreciate.

A schematic of the possible locus of cold fusion within

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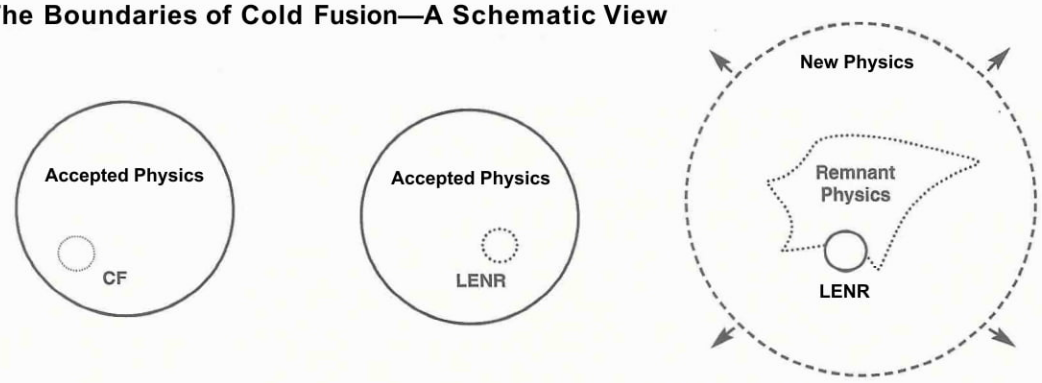
The Boundaries of Cold Fusion—A Schematic View



The Skeptics' View: "Cold Fusion" is "pathological science"—a "ghostly presence" within "Accepted" Physics, the latter being fundamentally almost "complete," *i.e.* a "Theory of Everything" is almost here.

"Mainstream" Cold Fusion View: LENR ("cold fusion") is a new branch entirely within "Accepted" Physics—No "New Physics" Needed.

Enlarged Physics View: LENR lies within a radically altered, extended Physics. LENR straddles what remains of "Accepted" Physics (a remnant) and the required New Physics.

by Eugene E Mallove

physics appears in the accompanying figure, which presents three broad perspectives. To the "skeptics," cold fusion still remains a troublesome residue of "pathological science." It sits within the pristine house of physics, spoiling an otherwise triumphal march to a glib "Theory of Everything." Next we encounter the "Mainstream" Cold Fusion viewpoint, which is probably held by over 98% of those directly involved in the field. Here the boundaries of cold fusion physics are completely confined within "Accepted" Physics, which for this community means quantum mechanics and relativity. In this view, only the chairs on the deck of the big ocean liner of physics need to be rearranged to accommodate the unexpected tourist—LENR. Creative cold fusion scientists must play the difficult game of fitting the experimental data with theories built of formalisms (the deck chairs) taken right out of reigning physics texts. This view gives the appearance of working more or less well, depending on the agility of the theorist.

Even some mainstream cold fusion theorists—notably Drs. Martin Fleischmann and Emilio Del Guidice (and the late Giuliano Preparata)—feel that the ocean liner of physics has lately been developing leaks in many of her lower decks. No, they do not believe the ship of physics is about to go down. But they do believe that some heavy patch-work is needed to save the ship and encompass not only LENR, but also what they consider to be otherwise unexplained phenomena throughout nature, including biological systems. Perhaps we should locate this Fleischmann-Preparata view somewhere between the second and third part of the schematic.

This third viewpoint, "Enlarged Physics," suggests that "Accepted" Physics needs radical surgery to remove dysfunctional dogmas and replace them with a New Physics that is yet soundly based on experiment—such as are being revealed in the LENR field itself. Obviously such a New Physics, while flying in the face of Accepted Physics theory, will have to be consistent with the data from Accepted Physics experiments. Such a view is Copernican in scope, and will necessarily meet with stiff resistance even by the "mainstream" cold fusioneers. These will wish to rely on the useful but now tired nostrums of host metal lattice dynamics, nuclear active sites, surface catalytic activity, and such other conceptual baggage that the thirteen-year-old isolated and in-grown scientific field has developed.

Indeed, the cold fusion field has grown to be very insular and self-contained. It has no idea of where it is located in time or space. It might even be said to be *lost* in time and space, realizing little if anything about surrounding fields of investigation that could lend it support. Many—make that *most*—cold fusion practitioners seem barely aware of other heretics at the gates of physics and what they have to offer. Or, if they are aware, they see no relationship between what they are doing in LENR and the work of those other heretics. They are also uncomfortable with these others, believing perhaps that "one deep heresy is enough."

I am speaking, for example, of the kind of heretical hydrogen research that is being carried out by Dr. Randell Mills and his colleagues at BlackLight Power (www.blacklightpower.com). Of course, Mills has made the situation more difficult by going out of his way to ignore and even disparage cold fusion research—as though his heresy of hydrino (shrunken hydrogen) physics (within his more encompassing "Classical Quantum Mechanics") is less heretical, or more soundly experimentally based than what cold fusion researchers have to offer!

But the ingredient most absent from the "mainstream" cold fusion view is that essence that must fill the "void" within and between atoms. That intolerable vacuum is now considered to be the space-time plenum in which matter and electromagnetic radiation reside. Oh, maybe a little "ZPE"—zero point energy—is admitted to the picture now and then by the mainstreamers, but nothing more than that from outside the textbooks.

It is not that it was unreasonable to begin with the assumption that textbook physics could explain cold fusion. It was and still is a worthwhile exercise. But it *is* unreasonable to exclude an *aether* (or ZPE) physics from cold fusion theorizing, when that aether could well be filling Nature's void and bringing about those relatively easy alchemical-like reactions. In the Mitsubishi experiment reported at ICCF9, for example, the mere passage of deuterium through a thin layer of either cesium or strontium led to the transmutation of either species. Yes, the element is in contact with a layer of palladium, but only at an interface (and perhaps that is where the bulk of the transmutation is occurring; this needs to be determined). I am also reminded of work reported years ago by Professor John Dash at Portland State University (Oregon) in which transmutation of elements on cathode surfaces seemed to be an ongoing process *after* the end of an experiment!

Whether a physically active aether as described in the experimentally and theoretically based form by Dr. Paulo

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and Alexandra Correa (www.aetherometry.com), by Donald Hotson (whose reconstruction of physics post-Dirac appears in this and the previous issue of *Infinite Energy),* or by someone else, cold fusion researchers should think about the possibility that an Enlarged Physics could help them explain what have proved to be resistant mysteries. But giving serious thought to the supposedly banished *aether* may be uncomfortable for many reasons—not the least of which is the intellectual and social problem of being involved with two heresies at once.

Finally, we come to the boundary of technological achievement: what new energy source will be first to enter the marketplace, and thus transform the boundary conditions for academic arguments in this area? Within the cold fusion arena, it appears that so-called "catalytic fusion" (pioneered by Dr. Les Case) and various thin-metal film technologies are leading contenders, but it must be said that progress has seemed painfully slow. Certainly it has been in light of my earlier anticipation that cold fusion would triumph in the mid-1990s.

It may be that LENR will have greater commercial applicability in radioactive waste remediation or in specialized rare element or isotope creation than in energy production. After all, if the on-rush of space energy physics (ZPE/aether) succeeds in getting robust engines to market, technologists may be loathe to spend resources to overcome the materials science issues that have always attended cold fusion excess energy phenomena. My advice to the cold fusion community is that it should reconsider the physics that bounds it. It will most likely find something just over the nearest hill or in the next valley that will help it out of its doldrums. And, as for competing power-generating devices, the cold fusioneers should definitely be looking over their shoulders. ♦♦♦

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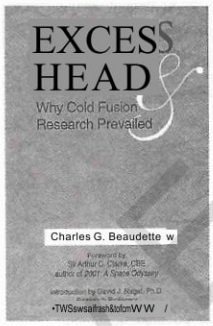

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In Memoriam:
Dr. John E. Chappell, Jr.

Dr. John Edgar Chappell, Jr. died Wednesday, June 5 in a San Luis Obispo, California hospital. John was a founder and the Director of the Natural Philosophy Alliance (NPA) since its origin in 1994. Its international membership has included more than 400 leading scientists who have engaged in scholarly discussions of alternative concepts and philosophies in physics at numerous conferences in the U.S. and abroad.

Dr. Chappell was pre-eminent among those seeking clarity in alternative concepts of contemporary physics, cosmology, and natural philosophy. Much of his life was devoted to promoting scholarly discussions and critiques of opposing viewpoints in those fields. Toward that end, he organized and chaired sessions in annual regional meetings of the American Association for Advancement of Science (AAAS), which attracted leading speakers and scientists from around the world. These comprised the largest group of such scholarly discussions ever held in the U.S., as recognized in *Galilean Electrodynamics,* Vol. 5, No. 6 (November/December 1994); *Apeiron,* Vol. 1, No. 20 (October 1994), and *Apeiron,* Vol. 2, No. 4 (October 1995).

John Edgar Chappell, Jr. was born November 16, 1933 to Dorothy Kober Chappell and John Edgar Chappell in Los Angeles, California. He graduated from Webb School, Claremont, California in 1950. He attended Harvard University, received an MA in history from the University of California, Berkeley, attended the University of Washington, Seattle, and received his Ph.D. from the University of Kansas in history (with an emphasis in the history of science) in 1968. Dr. Chappell taught at the University of Regina in Saskatchewan, Canada, Mankato State (Minnesota), and California State University, Chico. He was a research fellow at Harvard University in the 1970s.

In his role as NPA's director, Dr. Chappell organized and Chaired meetings, wrote a quarterly newsletter, and held a lively exchange among members and interested scholars worldwide. Between 1961 and 2002, he authored more than eighty-five scientific articles, chapters, and reviews in the areas of natural philosophy, physics, earth sciences, social sciences, and history. Some of his publications are those listed in the Directory-Bibliography of all NPA members and other scientists, which John prepared and distributed annually.

John is survived by his sister, Sarah Chappell Trulove of Lawrence, Kansas, a niece, Ann Trulove of Burbank, California, and a nephew, Lt. Col. Paul Chappell Trulove, Ph.D., of Annapolis, Maryland. Graveside services were held at Los Osos Memorial Park in San Luis Obispo, on June 25, 2002. Memorial contributions can be made to the Natural Philosophy Alliance, P.O. Box 14014, San Luis Obispo, CA 93406. E-mail contacts: trulove@ku.edu (Sarah Trulove); trulove@picture-editor.com (Ann Trulove).

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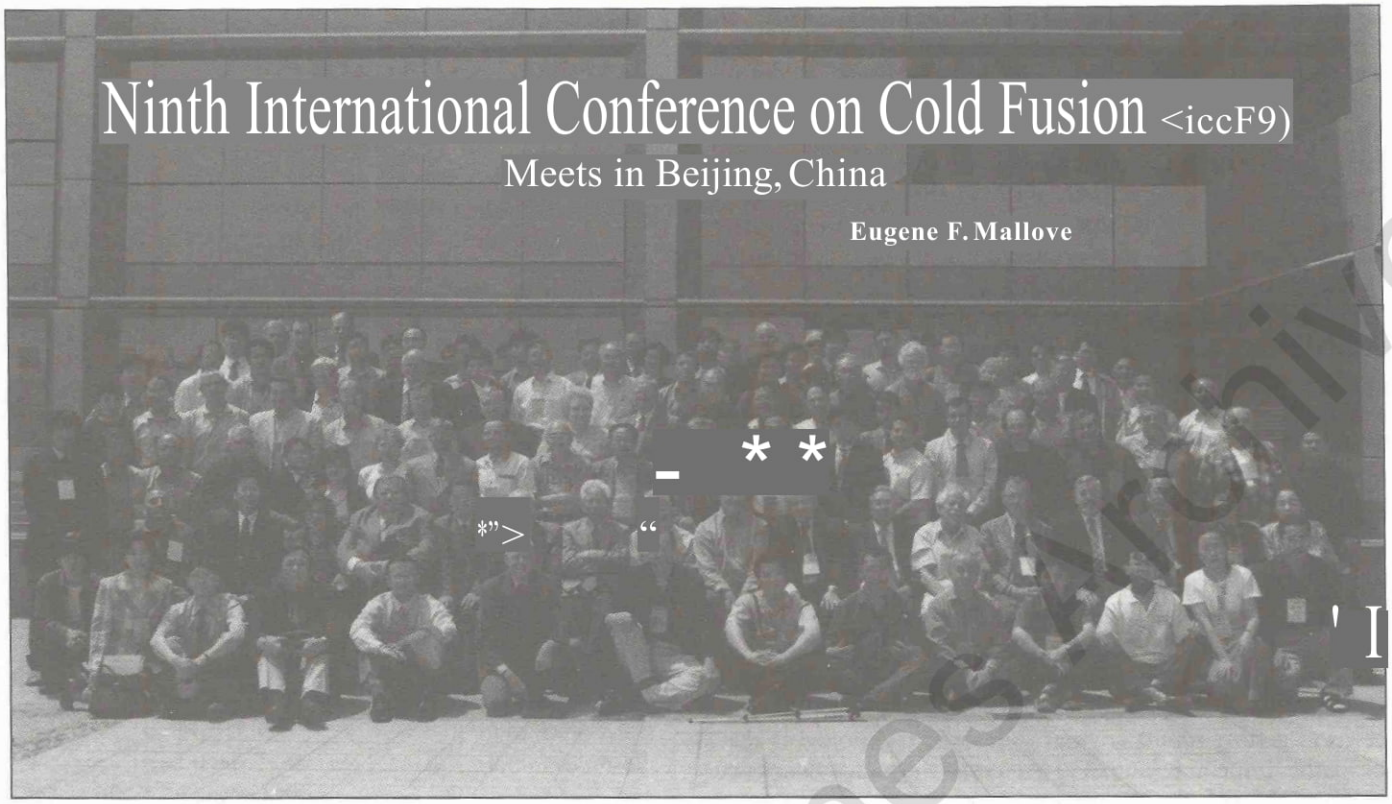
Ninth International Conference on Cold Fusion <iccF9)

Meets in Beijing, China

Eugene F. Mallove



f | he first International Conference on Cold Fusion of ■ the twenty-first century (ICCF9) was held at Tsinghua A University in Beijing, China from May 19 through May 25, 2002. Conferees gathered at the International Convention Center in the new, luxurious Uniscenter Hotel. New experiments with irrefutable evidence for nuclear-scale excess heat and nuclear products of low-energy nuclear reactions (LENR) made this a good step forward. Nevertheless, the lack of clear-cut evidence of progress toward near-term commercialization of the real but elusive excess heat phenomenon was disappointing. Still, it must be said that significant efforts to commercialize this new energy source are occurring worldwide, a fact not evident in the public discussions.

This ICCF9 report, prepared soon after returning from China, is only a brief overview of the conference. More reports may be published in future *IE* issues. Full technical papers will be in the conference Proceedings, which will be available for purchase from the ICCF9 website (http://iccf9.global.tsinghua.edu.cn).

ICCF9 was the first ICCF meeting to be held in China. The last one, ICCF8, was held May 2000 in Lerici, Italy (see report in *IE* #32). Two other ICCFs have been held in Asia: ICCF3 (1992) and ICCF6 (1996), both in Japan. Following the traditional Europe-Asia-North America rotation for ICCFs, ICCF10 will be held in the U.S., quite possibly in the Cambridge/Boston area, but certainly on the eastern seaboard. The chairman for ICCF10 is cold fusion theorist Prof. Peter Hagelstein of MIT's Department of Electrical Engineering and Computer Science—hence the pull toward the Boston area. ICCF10 will occur either in September or October 2003, because it was agreed among members of the international organizing committee that a two-year separation between ICCFs is too long.

ICCF9 was sponsored by: China's Fundamental Research Division of the Ministry of Science and Technology; the Physics Division II of the Natural Science Foundation of China; the Chinese Nuclear Physics Society; and the Department of Physics at Tsinghua University. It is gratifying to observe the open-mindedness of these Chinese science organizations. Would that ICCF10 could be sponsored by the U.S. DOE, NSF, the American Nuclear Society, and the MIT Physics Department. But please don't hold your breath for that!

According to the ICCF9 Organizing Chairman, Professor of Physics Xing Zhong Li of Tsinghua University, the conference had 124 attendees, with 17 "accompanying persons." The ICCF9 conference book contains 104 abstracts. The bulk of these papers were presented in poster sessions on three different days, with two to three minute oral summaries being given to the full assembly of participants. Presentations that were deemed to merit longer lectures to the whole group received 30 to 50 minute time allotments. Some 77 of the attendees were from abroad, but the rest were all from China, which appears to have an active interest in cold fusion, dispersed among a variety of physics departments and organizations. Known attendees and paper submissions (or abstracts) came from Australia, Belarus, China, France, Georgia, Germany, Greece, India, Indonesia, Israel, Italy, Japan, Romania, Russia, Spain, U.K., Ukraine, and the U.S.

Jed Rothwell provided this initial impression of ICCF9, which seems appropriate: "These conferences are more difficult to describe than they were a few years ago because experiments are much more sophisticated. Results are no longer binary: heat or no heat. Bare bones, basic repeatability is good in most experiments. Results are usually multifaceted: heat plus charged particles plus transmutations. When results are less than satisfactory, it is because they vary over a wide range and do not correlate well with one another. Expectations and standards are rising. A few years ago researchers were pleased to see

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Conference organizer Dr. Xing Zhong Li (R) and Tsinghua University Vice-President Yang Jiaqing.

The only speaker who talked openly and directly about an intent to commercialize was Dr. Les Case. His work, four years beyond ICCF7 in Vancouver at which he announced his gas-phase "catalytic fusion," has not yet emerged from the shadows. He spoke at ICCF9 in expansive terms, and indeed he has launched a real new and important area in cold fusion (possibly the *most* important direction), but it is still unclear how far from his goal he remains.

We worked very, very hard here at New Energy Research Lab (NERL) in Bow, New Hampshire to help Dr. Case use his big (100-liter internal volume) dewar cell to verify excess heat and try to achieve self-sustainment with his new proprietary formula—a patent-applied-for catalyst very unlike earlier ones that were successfully tested by him and others. Sorry to say, just after ICCF9 we came to this conclusion about our initial Case work after performing a second week-long series of runs with his catalyst: Almost no excess heat, possibly at most a few watts out of approximately 100 watts input. This is obviously far below self-sustaining, and it is possible that some unconfirmed defect was present in these tests. For his part, Dr. Case remains confident that various "know how" items have not yet been properly integrated into these experiments, because his own laboratory work with a smaller device evidences great performance, he says. Nothing would make us happier than to see our New Hampshire catalytic fusion colleague succeed brilliantly by creating the self-sustaining reactor he believes to be just around the corner. Other work on catalytic fusion, of a still confidential nature, is proceeding elsewhere in the U.S., using Seebeck envelope calorimetry of much smaller samples.

Conference organizer Prof. X.Z. Li's group at Tsinghua University reported excess heat (at 2 watts/cc level) in a gas-

something happening in most runs. Now they want to see the same thing happen to within an order of magnitude."

ICCF9 was similar to the other ICCFs since about ICCF6 in Toya, Japan—a mixed bag of very, very good material and experiments *(e.g.* the Mitsubishi Heavy Industries report on repeatable transmutations—see below), and lots of modest improvements, hints of progress here and there, as well as some very marginal experiments. My overall feeling about the cold fusion field is one of general sadness and pessimism, tempered with glimmers of hope. Certainly, the reality of these phenomena keep being re-emphasized with a widening circle of experiments, but the field is generally unheralded and/or disrespected worldwide. This was the first ICCF at which the infamous anti-cold fusioneer, Dr. Douglas Morrison of CERN, was not present to assault cold fusion researchers with ludicrous questions. Because of his passing last year, there will be no absurd critiques circulated to the outside world. This year, Robert Park of the APS was simply silent about ICCF9—his cold fusion "informer" was no more.

Almost no one in the cold fusion field seems to have a clue about what has to be done to energize the field—pardon the pun. And there is even peculiar, inexplicable concealment of certain advancements by some researchers. One example: Shortly before ICCF9, reports of a new cold fusion method developed by a respected U.S, researcher were circulating. It involves shining a low-power laser onto a coated cathode in an electrochemical cold fusion cell in calorimetric balance (no excess power). Remarkable, rapid increase in output power of the cell occurs when the red laser light hits an appropriate "active" spot on the cathode, or so it is said. Moreover, the effect is very repeatable. Yet for reasons that are not clear nor seemingly justified, no report of this work was provided at ICCF9. With that episode as background, the end-of-conference talk about "cooperation" and more rapid sharing of information seemed like so much hogwash.

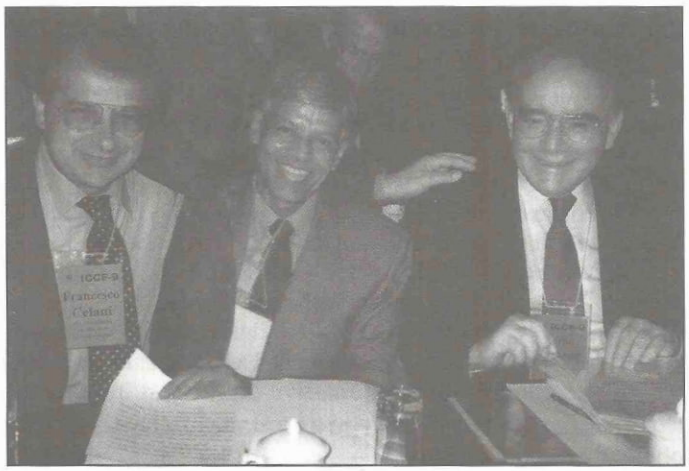

Photo by Eugene M<llove.

(L-R) Francesco Celani, Mahadeva Srinivasan, and Martin Fleischmann.

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loaded system involving palladium wire in a deuterium atmosphere. Gas-phase excess heat work of any kind bears a clear relation to what Case is doing in catalytic fusion, so this paper was of special interest. It speaks of a "pumping effect" of deuterium into palladium, a phenomenon which will certainly merit scrutiny by others.

Some very good news that may help commercialization efforts in the thin-film area: A group at Japan's Yokahama National University led by Drs. Ota and Fujii tried ordinary water electrolytic cells with thin-film-coated metal beads and tiny cylinders, similar to Dr. James Patterson's thin-metal film-coated plastic beads, which were so successful in the mid-1990s. (There are hints that cold fusion work at CETI may be coming to life again. Stay tuned!) The Yokahama group succeed in getting excess heat from about 25% of its cells. The excess heat was not very high—about 50% excess at maximum. Dr. Michael McKubre of SRI International had not been convinced about the calorimetry of Patterson cells before ICCF9, but in his summary toward the end of the conference he said that he was impressed with the Yokahama work.

There were numerous papers confirming various kinds of nuclear products—in Russia, China, and Japan. Prof. John Dash and Dr. John Warner at Portland State University reported excess heat results in the 10-25% excess range using titanium cathodes in heavy water cells. They also found that trace amounts of gold had formed during some runs, as detected by neutron activation analysis—a presumptive transmutation.

Dr. Iwamura *et al.* at Mitsubishi Heavy Industries Advanced Technologies Center had the most spectacular work, which will be reported in the *Japanese Journal of Applied Physics* later this summer. They used a very expensive vacuum chamber with *in-situ* XPS (X-ray photoelectron spectrometry) detection to observe the transmutation of an atomic species; cesium and strontium were used separately. The species is plated onto a palladium and CaO-layered sandwich of material through which deuterium gas passes as it is drawn through layers by vacuum on the other side. The upper surface (facing the D_2 gas) is 400 Angstrom-thick pure Pd, followed by a 1,000 A multilayer sandwich of CaO and Pd. Then the bottom layer, facing the vacuum, is 0.1 mm thick Pd. The upper D_2 gas-facing Pd layer has deposited on it the cesium (or strontium). Iwamura *et al.* obtained a *time-history* of the transmutation phenomenon: Cesium (Cs) transmutes to praseodymium (Pr), *i.e.* Cs-133 goes to Pr-141. As the Cs declined, the Pr increased correspondingly.

The group hypothesizes that there is a gain by the initial species of two alpha particles (two He-4) or a Be-8 nucleus! The time-history of the growth of the new species matched the decline of the old species. Contamination has been completely ruled out by exhaustive testing. In the case of strontium, the reaction is: Sr-88 goes to Mo-96. As detected by SIMS analysis, the molybdenum isotope produced is Mo-96, highly anomalous with no possibility of being naturally-occurring Mo. Overall, the Mitsubishi work is as close to being a confirmation of what might be called "modem alchemy" as can be imagined.

Italy, well-represented at ICCF9, has an official cold fusion program which operates at several centers. Also, it is known that the Pirelli Corporation at Milano has a working group in cold fusion. The group of Dr. Antonella DeNinno *et al.* at ENEA has apparently demonstrated massive excess heat in current-fed exploding wires laid down on a substrate in a D_2 gas atmosphere (this work was initially presented at ICCF8). Cold fusion pioneer Dr. Martin Fleischmann has concluded (told in private discussions) that this group has demonstrated *megawatts per cubic centimeter* of power, although the researchers claimed "only" 3-4 *kilowatts per cubic centimeter.* In private remarks, Fleischmann continues to be convinced that military authorities are now in on all of this and looking toward the use of cold fusion processes in weapons.

Of great interest concerning the Italian program is that physics Nobel laureate Carlo Rubbia has recently been quoted in the Italian press to this effect: he believes that cold fusion is real and important. Rubbia apparently was so eager to hear a firsthand report from ICCF9 that he called several Italian scientists home from the conference on the day before it ended. A delicious emerging irony in this: a nemesis of cold fusion from its early days, science journalist Gary Taubes, had written a book, *Nobel Dreams*—a scathing personal attack on Rubbia's high-energy physics work—this, long before cold fusion was announced. Rubbia may yet get his revenge on Taubes! (A further aside: U.K. physics Nobel laureate Brian Josephson continues to follow reports from the cold fusion field with great interest, and is dismayed that mainstream scientific publications are not paying attention to this work.)

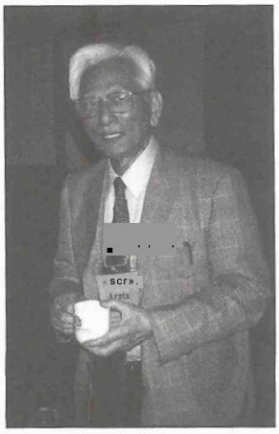
We also learned at ICCF9 that a small cold fusion group from Virginia has managed to secure a contract from the U.S. Army for a cold fusion experiment. It is also known that DARPA (Defense Advanced Research Projects Agency) in the U.S. has provided limited funding to a few high-profile cold fusion projects in academia (at MIT, of all places!) and industry, but whether such funding continues anywhere is not known. Dr. Edward Teller's associate, Dr. Lowell Wood of the Lawrence Livermore National Laboratory (a nuclear weapons research facility), attended both ICCF7 and ICCF8. At the latter conference, Dr. Wood seemed impressed with the quality of papers and appeared convinced of the reality of the phenomenon.

A four person group from Israel attended ICCF9. It was good to see interest from a country that perhaps more than any other might benefit from the advent of the peaceful use of cold fusion energy.

Roger Stringham of sonofusion fame (First Gate Energies, Inc.) has moved his laboratory to Hawaii from California. He gave a talk at ICCF9, basically a review of his ultrasonic implantation of deuterium into metals. He reiterated his findings of helium-4, helium-3, and tritium in some of his earlier experiments.

Professor Yoshiaki Arata and Dr. Y.C. Zhang presented research in the same general area in which Stringham works, which is reported in two recent papers. Here are the abstracts:

"Intense Sono-implantation of Atoms from Gases into Metals," *Applied Physics Letters,* 1 April 2002, Vol. 80, No. 13, Yoshiaki Arata and Yue-Chang Zhang, Cooperation Research Center for Science and Technology, Osaka University, 11-1 Mihogaoka, Ibaraki, Osaka 567-0047, Japan.



Yoshiaki Arata.

Abstract: It was found that various gaseous atoms can be easily implanted into metal powders under ultrasonic cavitation inside a vessel with water

(H_2O, D_2O, or a mixture thereof). Inert gases (^3He, ^4He, Ne, and Ar) and others (N_2, air, H_2, and D_2) were strongly sono-implanted into metals such as Ti, Fe, Ni, Cu, Zr, Pd, Ag, Ta, Pt, and Au, which were originally set in the vessel as foils, and were broken into ultrafine metal powders during intense ultrasonic processing. A large amount of implanted atoms was verified to exist in these powders from mass spectroscopic analyzes.

"Nuclear Fusion Reacted Inside Metals by Intense Sono-implantation Effect," *Proceedings of the Japan Academy,* Vol. 78, Ser. B, No. 3 (2002), Y. Arata, Y-C. Zhang.

Partial Abstract: "Using intense ultrasonic cavitation effect, metals kept in heavy water were changed to nanometer-sized fine powder and simultaneously condensed a large amount of deuterium for 1 ~ 2 days. Mass analyzes of gases released from the revenant metal powders revealed existence of ^3He and ^4He. . .excess energy was recognized in only D_2O working liquid. . ."

The work employs foils of Ti, Pd, Ag, Ta, Pt, and Au from which nanometer-sized powders are created that are deuterium-loaded. It was disappointing that Drs. Arata and Zhang did not acknowledge Stringham's work, which certainly is related to theirs and preceded it. This is but one small indicator of the mind-boggling fragmentation that goes on in a field that is itself under attack from the outside. I have told my cold fusion colleagues for years: "We're in a life-raft together already. Nobody should be poking holes in the life-raft!"

One of the key concepts that has emerged prominently at both ICCF8 and ICCF9 is that of *flux* of hydrogen (deuterium or protium) into and through metals as a beneficial attribute for producing LENR reactions. The term *flux* is to be considered in contrast to the parameter of *loading ratio* (the ratio of hydrogen nuclei to the number of metal lattice nuclei), which was much discussed in past conferences as a necessary condition for excess heat production. This important theoretical concept had been put forth long ago by Dr. Mitchell R. Swartz, of Jet Energy Technology, Inc. of Massachusetts.[1,2] At ICCF9, Dr. Swartz's work on optimal operating point excess heat determination was highlighted when Prof. Hagelstein narrated a video tape that Swartz had prepared for the APS meeting this past spring.

The Wednesday in the middle of the conference was devoted to a sight-seeing and technology-related outing for the conferees. We were transported via two large buses through some horrible traffic jams in Beijing, and outward on free-flowing superhighways toward the Great Wall of China (at Badaling). For a few hours we all walked and climbed the awesome, ancient structure, which stretches some 7,000 kilometers over mountaintops and into valleys across China. It was a relaxing interlude.

The outing also featured a stop at the Beijing Ti-Gold Great Wall Corporation, whose primary business is using ion-implantation to coat decorative and architectural objects (metallic and non-metallic) with a luscious film of gold overlaying titanium. The company also sells ten models of ion-implanting machines and vacuum chambers. The company was one of ICCF9's sponsors. President and owner of the company, Prof. Wang Dian Ru, has taken the bold step of financing a collaboration between his company and Tsinghua University on a major cold fusion experiment. (To my knowledge, no such collaboration on a cold fusion

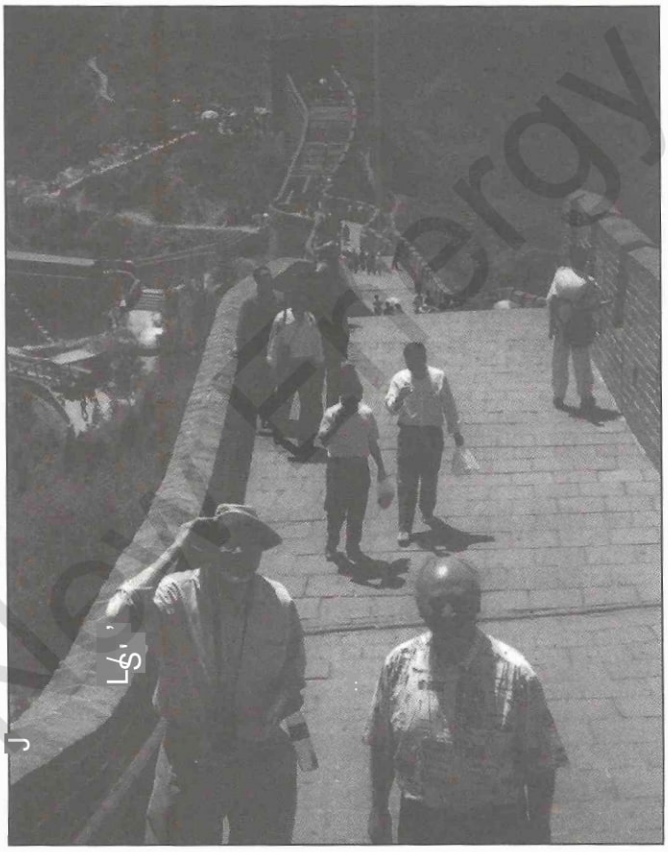


Photo by Eugene Mallove.

Tom Passell (L) and J.P. Siberian (R) at the Great Wall.

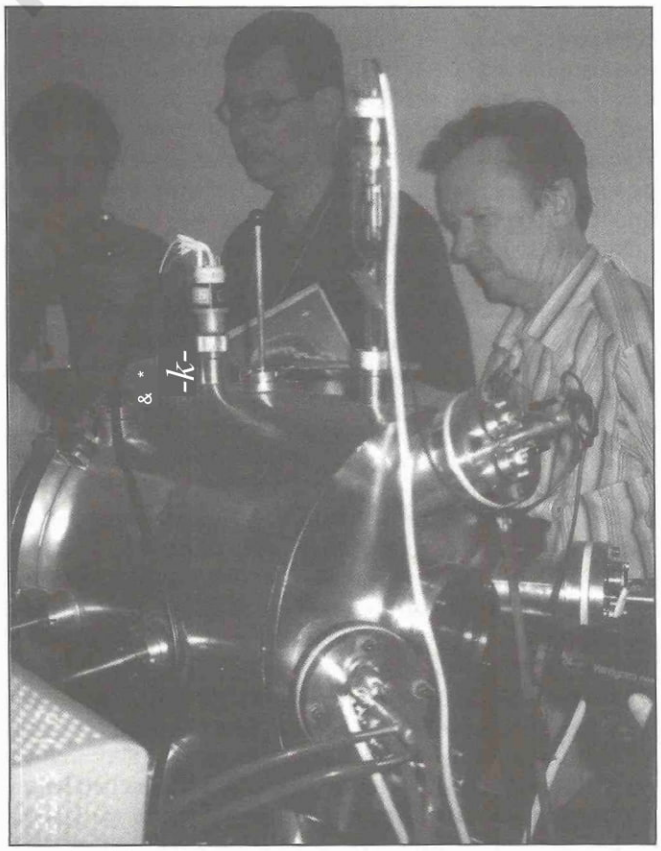


Photo by Eugene Mallove.

(L-R) Gianpaulo Nogara, Shaul Lesin, and V.A. Kirkinskii at the Ti-Gold Corporation.

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Photo by Eric Allove.

Luca Gamberale of Pirelli Corp. (L) and Didier Noel (R).

experiment exists in the United States.) Students, graduate students, and one of Dr. X.Z. Li's post-doctoral associates work on the project, which bears some relation to the earlier-described Mitsubishi Heavy Industries experiment. A state-of-the-art IR camera that peers through glass ports provides a measure of metal temperature distribution caused by the deuterium that is made to penetrate palladium and other metal substrates in the vacuum chamber.

The concluding day of the conference was largely devoted to reviewing what ICCF9 had accomplished and "where to go from here." The perennial discussion arose concerning the two-humped distribution of numbers of cold fusion researchers plotted on a graph against their ages. The bulk of researchers are, indeed, getting on in years and by retirement, illness, or death will be disappearing—perhaps before the hoped-for victory party at the humorously posited ICCF15. So, how will the much smaller "hump" of younger researchers be able to carry out all the work that must be done? How to get more people involved in the field? Remarkably, not a peep was heard during this multi-hour review about developing commercially available *demonstration units*—or about cold fusion commercialization period! I held back my frustration and did not speak to that point (as I had at ICCF8), for fear of being impolite to the tired group of colleagues.

One way to gain greater acceptance may be to form a peer-reviewed journal for the field, because with Prof. George Miley leaving as editor, *Fusion Science* (formerly *Fusion Technology)* appears no longer to be allowing LENR papers among its hot fusion pages. (Such papers are said by the new editor to be "not of interest" to the readership.) Some bright news: Professor Peter Hagelstein of MIT told us that he has been discussing with a major science journal publication house the possible launch of a "Condensed Matter Nuclear Physics" journal.

Professor A. Takahashi of Osaka University discussed his experience in helping to found the Japan Cold Fusion Society. There was discussion of whether cold fusion communities in other countries should form similar national cold fusion societies, and should there be an "International Cold Fusion Society."

The latter question went unresolved. Prof. Hagelstein and Jed Rothwell are eager to have a more permanent web presence for cold fusion, in the form of permanently posted archival papers and notices. This will undoubtedly be launched before ICCF10. (Indeed, just as this issue went to press we learned that a skeletal site, www.LENR.org, has been posted.)

Final Thoughts: China

The struggle and ferment in the cold fusion field was exposed at ICCF9 amid the backdrop of the great business turmoil and industrialization now going on in China. This heretofore sleeping giant is clearly in the process of waking up to new ways. This is evident in huge billboards everywhere touting both Chinese and Western industries in the computer, energy, and biotechnology fields. Though the People's Republic of China may be a communist nation, capitalism is rampant there. New enterprises are popping up everywhere on the streets of Beijing—especially cell phone businesses. Many shops were lined up on a single street, each selling cell phones! In one bookstore I visited, a large number of items were Chinese translations of popular business-culture "how to" books from the West. Large numbers of bicycles and tricycle cargo-carrying vehicles were everywhere, but Beijing has millions of cars and new buses too. The infrastructure is being inexorably built up. It was very charming to observe the *bamboo* construction scaffolding on high-rise buildings in the works. Some ICCF9 attendees likened the atmosphere of China in 2002 to Japan in the early 1970s.

Across from the very Westernized hotel in which the conference was held, an entire city block of single-level masonry buildings was leveled during the five-day conference! This to make way for some new construction in the bustling Tsinghua University area. The leveling was begun by dozens of workers with sledgehammers and pick-axes, followed by only a single backhoe type machine. Most of the debris was carefully recycled and taken away by dozens of tricycle vehicles as well as numerous horse and donkey-drawn flat-bed carriages. Even the old bricks were carefully packed in regular arrays for recycling. Ditto for little pieces of scrap metal and old, worn wire. It was simply amazing. Perhaps the cold fusion field will trigger a similar and long-overdue leveling—a demolition—of weak structures and obsolete paradigms in physics, even though most cold fusioneers seem quite oblivious to this prospect. ♦♦♦

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COLD FUSION TIMES

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Announcement of Russian Cold Fusion Conference

For those who simply can't wait for ICCF10, a near-term intermediate cold fusion conference will be held in Russia this fall. At ICCF9, the Russian conference co-organizer, Dr. Igor Goryachev, gave an excellent review of impressive cold fusion activities by many groups in Russia. Indeed, both Russia and China are countries to watch when it comes to cold fusion. Here is the invitation to the Russian conference, with an indication of its elite sponsorship:

Russian Academy of Sciences
Russian Physical Society
Nuclear Society of Russia
Mendeleev Chemical Society of Russia
Moscow Lomonosov State University
Russian Peoples' Friendship State University
State Technical University (MADI)

Dear Colleagues,

The 10th Russian Conference on Cold Nuclear Transmutation and Ball Lightning (RCCNT & BL-10) is to be held from September 29 - October 6, 2002. The place of the Conference is in Dagomys near the city of Sochi, which is the best recreation and holiday place on the Black Sea shore of Russia.

The program of the Conference includes the following subjects:

- Experimental research in cold fusion, transmutation, and ball lightning;
- Theoretical models with respect to cold fusion effects;
- Applied technologies and devices.

The organizing Committee of the Conference is pleased to invite you to attend the Conference. The terms of your participation are as follows:

The full cost is $900, which will include the registration fee, hotel reservation and living, three daily buffet meals, conference proceedings, transportation from the Sochi airport and back, social dinner and special excursion or entertainment.

The languages of the Conference are Russian and English. The total cost is $800, if transferred before August 10, 2002 to the bank account of the Organizing Committee (which will be designated on confirmation of your decision to attend the Conference).

If you decide to take part in the Conference, please let us know before July 20 the title and abstract of your report.

Contact telephone: (7)(095)196-9476 (ask for Mr. Igor Goryachev)

Fax: (7)(095)196-6108

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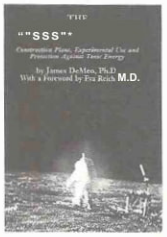

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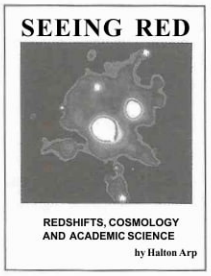

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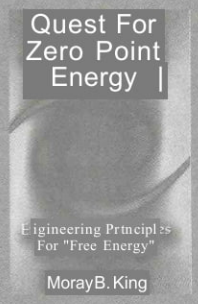

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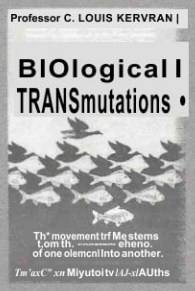

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Dirac's Equation and the Sea of Negative Energy

PART 2

D.L. Hotson*

Summary Of Part 1 *(Infinite Energy,* Issue #43)
We show that the Standard Model (SM) of particle physics is totally inadequate by any reasonable criteria, violating the basic scientific rules of simplicity, mathematical consistency, causality, and conservation. All these violations stem from the 1930s, when by a mathematical trick the Dirac wave equation was truncated to eliminate its negative energy solutions. Recent developments, however, have shown that *time* is quantized (Treiman, 2000), thereby eliminating the very basis of that mathematical trick, as it would involve massive violations of conservation of mass/energy.

The energy equation and Dirac's equation call for both positive and *negative* energy. Thus they are symmetrical with respect to energy, as are the forces of physics. We show that positive (repulsive) forces increase positive energy, while negative (attractive) forces, such as gravitation, the strong nuclear force, and the Coulomb force between unlike charges, all increase negative energy. According to the modern kinetic theory of mass-energy, negative energy would merely be a vibration of charges at right angles to our ordinary dimensions, in an "imaginary" direction. The equations of QM, which all include *"i",* therefore indicate that these functions are *complex,* including vibrations in "imaginary" directions. This understanding explains several anomalies with the electron, such as its velocity eigenvalue of $\pm c$, which can only be in an "imaginary" direction. It also explains the electron's anomalous spin of ft/2.

The solutions to Dirac's equation describe a "spinor" field in which electron changes to positron every t, the quantum of time, ($2e^2/3mc^3$, equal to 6.26×10^{-24} seconds). An electron-positron pair ("epo") therefore must form a neutral spin-zero boson with electron and positron alternating every t. A quantum field such as the Dirac spinor field *must* give rise to particles, unlimited numbers of them (Gribbin, 1998b). Therefore, the Dirac field must give rise to a "sea" of negative-energy bosons which, since they are "below zero," must form a universal Bose-Einstein Condensate (BEC).

This universal BEC can not exist in the presence of unbalanced charges, so every unbalanced charge must instantly be surrounded by epos raised from negative to positive energy. They connect and neutralize every unbalanced charge, forming the "electromagnetic field," which is composed of chains of one-dimensional epos connecting and balancing every unbalanced charge. They carry charge "by proxy."

The universal BEC can't abide positive energy either. When an electron jumps from a higher energy level to a lower one, thereby losing (positive energy) angular momentum, this momentum is absorbed and carried by the epos that surround it, forming a wave of epos carrying angular momentum, which carry the "photon" according to the Feynman "path integral" version of QM. The pattern of these epos form the photon's 'I' wave.

A "Theory of Everything"?

We have seen the power of Dirac's equation, when *all* of it is taken seriously. In a sense, though, Dirac took it even more seriously. It is *not* an equation of the electron, as it is popularly called. It is a relativistic generalization of the Schrodinger wave equation, which is said to "contain most of physics and all of chemistry." Dirac thought of it as a Theory of Everything—he thought that its solutions should include "everything that waves," *i.e. every possible particle.* As he was deriving it, he hoped it would have only one solution—the one, unitary particle out of which everything could be made (Dirac, 1933). Then, when he found that it had multiple solutions, he thought that one of its solutions must be the proton—as at that time, the proton and the electron were the only known particles, and it was fervently believed that they were the *only* particles. This is why Dirac, in several of his early attempts to use the equation, entered in as the mass the *average* mass of electron and proton (Pais, 1994). This didn't work, convincing him that the other "real" particle (the other *positive energy* one) had to have the same mass as the electron, but the opposite charge. Thus he predicted the positron, but gave up his dream that his equation was a "Theory of Everything." (Of course the discoveries of the neutron and the positron, and the conviction that the photon also was a particle, didn't help any.)

So, powerful though this equation is, it did not live up to its discoverer's expectations. It was not unitary, and failing that, it was not even a Theory of Everything.

The annoying thing is, it *should* be. It generalizes a very generally applicable equation—the Schrodinger wave equation—and makes it covariant. We have seen that every one of its requirements and predictions, including the negative-energy epo, has withstood every test. It is as valid and widely applicable an equation as has ever been discovered. It is as general as the whole universe. It *should* describe "everything that waves." Yet as solutions, instead of general ones, it has particular ones: just the positive energy electron and positron, and their negative energy counterparts. In a sense, though, that *is* unitary: two of the four are just different *energy states* of the same particles, and electron and positron *turn into* each other

> What if Dirac was right to begin with about his equation? What if those four kinds of electron, two negative and two positive, are all one needs to build a universe?

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every half cycle—they are really the same particle, merely out-of-phase with each other (Huang, 1952). So one could say that the four solutions to Dirac's equation *are* unitary—they describe four kinds of electron, differentiated by *state and phase.*

What if Dirac was right to begin with about his equation? What if those four kinds of electron, two negative and two positive, are all one needs to build a universe? There are, after all, no wave equations for quarks, or for gluons, or for any of the other supposedly "fundamental" particles—yet they all wave. Could this mean that they are not fundamental at all? We will leave this question hanging while we consider a related one.

Where Do You Take Out the Garbage?

This famous question, invariably asked of architecture students with regard to their beloved projects, has much wider applicability. No organism (or energetic machine, for that matter) can function indefinitely in an environment of its own waste products. (A dilemma that increasingly confronts the increasing numbers of mankind.)

The BEC, as these equations outline it, is not perhaps an organism, but it is an energetic machine. Overall, it is completely ordered, covered by a single wave function. But in detail, it is a hive of activity, full of charges going at the speed of light. Its frantically gyrating epos fill every cranny in every dimension of the negative energy realm. However, the close quarters and random configurations must frequently put electron adjacent to electron in positions that generate considerable amounts of *positive energy.* (Like charges repel, which is positive energy.) The BEC can't stand positive energy. It *must* get rid of it.

The BECs we can generate, at temperatures near 0°K, need fierce refrigeration to maintain their integrity. The Big BEC is somewhere below zero. How is *it* refrigerated? Where do its waste products go? Where does the BEC take out the garbage, and where is its garbage pile?

I suggest that we are sitting in it. We seem to be, to put it bluntly, BEC excrement.

The BEC must generate positive energy in great quantities. All of its dimensions are full, even if it could accommodate the stuff. It *has* to get rid of it. So it is no coincidence that "our reality" has a large positive energy balance. We are the BEC's dump. (Literally, its "heat dump.")

We have seen that the effective boundary between the positive and negative energy realms is several degrees above absolute, as BECs, superconductivity, and superfluidity all begin to happen there. Mercury becomes a superconductor at 4.1°K. An "ideal gas" will form a condensate at 3.1'K. However, for real substances, because of interactions between the molecules, the figure is somewhat lower. (The critical temperature for helium liquid is 2.2°K.) This would seem to put the boundary right around 2.7°K, or at least too close to this figure to be coincidence. We would expect the number of photons "dumped" from the BEC to peak there, falling off randomly on either side of this peak to form a "black body" spectrum peaking at this temperature. This would seem to be the most probable explanation for some or all of the "microwave background." In any case, this vast number of photons seems much more likely to come from the negative territory adjacent to it, than from a Bang at the complete other end of the spectrum. (The infinite temperatures of a Bang can not be the "proximate cause" of an energy field near absolute zero.)

Why would the numbers of photons peak at this temperature, instead of increasing all the way down to zero? This is because, if the boundary between positive and negative is 2.7°K, photons with less energy than this would randomly drop back into the condensate and out of "our reality"—the less positive energy, the faster they would drop, forming the lower curve of the black body.

> in a total and massive reversal of our expectations, the compound nucleon appears to be nearly twice as abundant as the simple electron. This immense anomaly cries out for an explanation. It is the clearest kind of indication that the production of nucleons themselves and the process of nucleosynthesis follow entirely different kinds of laws for some unknown reason.

If our positive energy reality is indeed made of "exhaust" from the BEC, then everything must be made of electrons and positrons, as that is all the BEC has to offer. However, "pair production," one epo at a time splitting into electron and positron, leaves no net positive energy balance, as equal numbers of them must sink back into the sea. The BEC must have some other means of permanently expelling the large amounts of positive energy that make up our reality.

p-decay

There is a major, unnoted anomaly in the relative abundances of the three entities out of which all stable matter is made. The numbers of electrons and protons appear to be exactly equal. (By charge conjugation [C] and charge conservation as outlined above, they must be *exactly* equal.) And while the most common element, hydrogen, contains no neutrons, there is an excess of neutrons in the more complex elements. If you count the unknown but probably large number of neutron stars, there seem to be nearly as many neutrons as protons. Thus there appear to be *nearly twice as many nucleons as electrons.*

However, unlike the simple electron, which seems to have no parts, there is abundant evidence that nucleons are not fundamental. They do have parts, almost certainly not just a few parts, but swarms of them (Krisch, 1987; Pais, 1994; Rith and Schafer, 1999). Somehow those parts must have been assembled to make the nucleon. Modern theory dismisses this as just another miracle. However, if nucleons came together in the same kind of way as the chemical elements, with compound units being compounded of simple ones, we would expect electrons to be much more numerous than nucleons. How can a *compound* entity be more abundant than a *simple* one? Simple hydrogen is about 10^{12} times more abundant than compound uranium, which masses about 238 times as much. The compound nucleon masses nearly 2000 times as much as the simple electron, so by this comparison we would expect electrons to be at least 10^{13} times more abundant.

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Instead, in a total and massive reversal of our expectations, the compound nucleon appears to be nearly twice as abundant as the simple electron. This immense anomaly cries out for an explanation. It is the clearest kind of indication that the production of nucleons themselves and the process of nucleosynthesis follow entirely different kinds of laws for some unknown reason. Nucleosynthesis takes place in stars, and involves an additive process: individual nucleons, or at most alpha particles, are added one by one to produce the heavier elements. This explains the relative rarity of these heavier elements, as much more energy, special conditions, and quite a bit of luck (or "fine tuning") are necessary to produce them.

However, because of their anomalous abundances, compound nucleons must be produced in some entirely different manner than the additive process that produces the heavy elements. This is a major indicator of what that process might be—and what it is not. (It virtually rules out, for instance, the production of these abundances in a "Bang," big or little, as production in a "Bang" would mimic the additive processes of solar nucleosynthesis, and produce orders of magnitude more leptons than nucleons.)

If there were some one known subatomic process whose end products were neutrons, protons, and electrons in their very anomalous observed abundances, with *almost equal* numbers of each, we could be virtually certain—to a vanishingly small uncertainty—that *this* is the process by which the universe came about. Is there such a known process? As it turns out, there is exactly one such known process: it is called P-decay.

Outside a nucleus, the neutron is unstable, but with an extraordinarily long mean lifetime. Whereas all of the other known unstable particles decay in nanoseconds or less, often much less, the neutron hangs around for 14.8 minutes on average. After this uniquely long lifetime, a lone neutron will break down, emitting an electron and an antineutrino, and turning into a proton. The antineutrino is almost never seen again—it could go through light-years of lead without interacting. But this process produces electrons and protons *in exactly equal numbers.* (They of course form hydrogen, the most abundant atom.) Moreover, the neutron itself, if it happens to be absorbed into a nucleus during its 15-minute mean lifetime, is again completely stable. (Except in certain radioactive nuclei.) And in stars, where nucleons are combined into nuclei, there is abundant energy available to fuse electrons and protons back into neutrons, where needed (Conte, 1999). This, of course, happens wholesale, in degenerate stars.

So *given enough neutrons,* the process of beta decay, alone and unaided, would produce exactly the very strange abundances of the universe we observe. Moreover, we know of *no other process* whose end products would be electrons and protons in exactly equal numbers, and neutrons in approximate equality. And since all stable matter in the universe is composed of just these three products in just these proportions, it follows that no other process is/was of any importance.

> We can be almost totally certain that whatever else happened, the universe we know began as a whole bunch of *neutrons,* and nothing but neutrons.

So just from this, we can be almost totally certain that whatever else happened, the universe we know began as a whole bunch of *neutrons,* and nothing but neutrons. (Another indication that no Bang happened.) But there is one other significant fact. Beta decay is a "weak" interaction. As such, it does not obey the symmetry rules obeyed in virtually all other interactions. It is "left-handed." Specifically, it violates both parity (P) and charge conjugation (C) (Pais, 1994), which is the production of matter and antimatter in equal amounts. Since a massive violation of C is necessary to produce a universe of matter rather than antimatter, beta decay's violation of C is highly significant. (We will examine the specifics later.)

Sherlock Holmes was of the opinion that "singularity is almost always a clue." And concerning the neutron we have *three* singularities, each reinforcing our thesis that the universe began with large numbers of lone neutrons. Each neutron was born anomalously left-handed, with the extraordinarily long mean lifetime of 15 minutes, and with the further very peculiar property of being completely stable once inside a nucleus. Without any one of these unique properties, the neutron's decay would *not* produce the peculiar abundances of the universe we observe. Each of these peculiarities would seem to be evidence for this scenario; together they virtually exclude any other.

So the big question now is: How does one make a neutron? Well, this argument certainly suggests an answer. We have seen that according to every experiment ever performed, matter and antimatter are always produced in exactly equal amounts. The experimental evidence therefore demands a universe equally of matter and antimatter. *Since the universe must be composed of equal amounts of matter and antimatter, and since the early universe was composed uniquely of neutrons, the neutron must be composed of equal amounts of matter and antimatter.* It's very simple: the neutron must be made of electron-positron pairs.

One further indication: we showed earlier that the epo one-dimensional "string" must be re in length, or 1.87 x 10^{-15} meters long. If the neutron is made of epos, presumably this "string" length would have to be the diameter of the neutron. Within the limits of the scattering measurements, *this is exactly the measured diameter of the nucleon.*

So it would seem that there are several different approaches, all of which suggest that Dirac was right the first time about his equation. Perhaps it *is* a Theory of Everything, and a unitary one at that. Everything seems to be made of epos: the electromagnetic field, the T wave, the photon. If the neutron could be made of them also, that would be a clean sweep, at least of the universe's stable entities.

Neutrosynthesis

We might say that the Dirac equation, by having only four roots, *predicts* that everything else, including the neutron, must be made of electrons and positrons. How many epos make a neutron? The question is far from trivial. The answer can not be 919, the mass ratio between epo and neutron. There would be 919 x 2 like charges packed into a tiny space. The binding energy would have to be 80 or 90%, to hold such an aggregation together, even if it were mostly "charge condensed." So 919 epos would mass, at most, about 370 electron masses. We might keep in mind the Pauli exclusion principle, which regu-

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lates how many electrons may occupy a given shell in an atom by the possible number of different vibrational modes (different quantum numbers).

We have seen earlier that for reasons of symmetry the universe must have ten dimensions, six of them (the negative energy realm of the EEC) in "imaginary" directions with respect to our four (Dirac, 1963; Sirag, 1977b, 2000). How many different ways can an electron or positron vibrate in ten dimensions? We might answer that by an analogy with the periodic table.

Each electron shell contains the number of electrons that can vibrate in different ways. (The electron's quantum numbers.) At present, the periodic table consists of 100 elements in eight complete shells (if you count the rare earth elements) with 16 or so elements in an incomplete ninth shell. (Element 118 was claimed to have been synthesized at the Lawrence Livermore National Laboratory in 1999, but they have recently retracted that claim [Gorman, 2001].) Completing that shell would give 118 elements, and a tenth complete shell would add another 18, for a total of 136. So if elements were stable to atomic number 136, element 136 would be a noble gas with 136 electrons in 10 complete shells. This means that there are 136 different ways for electrons to vibrate in 10 shells. Each of these shells amounts to an additional *degree of freedom* for the vibrating electron. If we substitute 10 degrees of freedom, or *dimensions,* for these 10 shells, it seems inescapable that there again would be 136 different ways for electrons to vibrate in 10 dimensions.

These numbers figure prominently in one of the possible designs for a neutron made of electron-positron pairs. This model was largely suggested by Saul-Paul Sirag (1977a) as a "combinatorial" model of the proton. He, however, considered it mere number-juggling. The last time I talked to him, he was no longer interested in it, so I "pirate it" without scruple. With a few minor additions and changes, it turns out to be a plausible model of the neutron.

> . . . From Eddington's group-theoretical point of view, creatures to whom space-time has four dimensions will find algebraic structures having 10 elements and 136 elements playing a very fundamental role.
>
> Eddington attempted, unsuccessfully, to derive the proton-electron mass ratio from the two numbers 10 and 136, together with the number of unity, 1. . . Eddington's 1, 10, and 136 are members of a well-known mathematical series that goes 1, 10, 45, 136, 325. . .etc. . .The next number in that series is 666. (Sirag, 1977b)

Eddington's series is $(n^2)(n^2 + 1)/2$, n = 1, 2, 3, etc. As Sirag points out, this group-theoretical point of view accords with Dirac's above statement that four-dimensional symmetry requires ten dimensions of curvature, or degrees of freedom, in General Relativity (Dirac, 1963). Several of the string and superstring theories also require a space of ten dimensions (Sirag, 2000), and as we saw, an electron can vibrate in 136 different ways in ten dimensions. If we order these 136 vibrational modes two at a time—one for electron, one for positron (as in the epo)—this would give 136 x 135, or 18,360 different ways for a lepton, joined as an epo, to vibrate in 10 dimensions. (This is Sirag's computation, but he lacked the idea of electron-positron pairs. He ordered them two at a time ". . .*e.g.,* one for proton, one for electron. . .")

Thus a combination of 9180 electron-positron pairs would be a very stable arrangement, filling *all* of the possible vibrational modes in ten dimensions. We might imagine them arrayed in a 10-dimensional vortex or "hypersphere." (Note that this arrangement would come about in the negative-energy BEC. As is well known, the *only* way that a BEC can rotate is in a vortex.) Moreover, Krisch (1987) has shown that colliding protons act like little vortices, shoving each other around preferentially in their spin directions.

What would be the mass of such an aggregation? Well, in quantum theory, one measures the energy, or mass, by taking the *temporal sine* attribute of the T wave. Since time is only one of the 10 dimensions, this would give the aggregation a mass of 18360/10, or 1836 electron-masses. Since it is composed of 9180 electron-positron pairs, such an entity would have 0 charge: it would be neutral.

All symmetries are conserved in this arrangement, with exactly equal amounts of matter and antimatter. There is no reason why such an entity might not be produced, and expelled from the BEC (thrust into "our reality") whenever

With this single, simple model for the production of neutrons from the unique solutions to Dirac's equation, we arrive at the extremely anomalous numbers of electrons, protons, and neutrons in our reality. Moreover, this also explains the preponderance of hydrogen over every other atom. Also explained is the oddity that electron and proton, which are seemingly very different particles, nonetheless have *exactly* the same electric charge. A proton is seen to be simply a neutron that has lost a single electron, leaving it with an extra positron. And the electron is not "created" as it leaves the neutron; it was there all along. . .Moreover, it would seem to admit of the possibility that energy, special conditions, and catalysis might synthesize neutrons at low temperatures, possibly explaining some or all of the neutrons, transmutations, and excess heat produced in cold fusion.

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the random fluctuations of the BEC produced a positive energy of 1836 electron-masses, and spin energy in all ten dimensions. (The suggestion is that it would be produced in a vorticular "storm" in the BEC, which would have spin energy in all ten dimensions.) Moreover, since it has only 10% positive energy and 90% negative or "binding" energy, such an entity would be stable despite packing 9180 charges of like polarity into a very small hyperspace. This is the Sirag model of the nucleon, slightly modified. Note that in our BEC.of unlimited density, there is already an electron and a positron in exactly the positions required for this synthesis (nothing needs to move), so only the positive energy and the spin is required to produce a neutron.

The mass of a neutron is, of course, 1838.684 electron masses, not 1836. However, mass is a tricky business. The "effective mass" can be quite different from the "bare mass," as is shown in the conduction atoms of a metal (Pais, 1994). Because of their interaction with other electrons and with the positive core, their effective mass can vary from 0.3e to over lOe. And in a superconductor, "condensed state" electrons can have an effective mass that can be 1000 times the "real" electron mass. We will later show that epos in a nucleon are in a semi-condensed state. Furthermore, there are indications that mass may vary with time (Narlikar and Das, 1980).

Among the felicities of this model, Sirag points out that if you divide the 18360 successively by 9, 8, 7, and 6, you get the approximate mass-ratios of the other baryons, the Lambda, the Xi, the Sigma, and the Omega. Since they have larger ratios of positive (disrupting) energy to negative (binding) energy, these baryons are progressively less stable.

With this single, simple model for the production of neutrons from the unique solutions to Dirac's equation, we arrive at the extremely anomalous numbers of electrons, protons, and neutrons in our reality. Moreover, this also explains the preponderance of hydrogen over every other atom. Also explained is the oddity that electron and proton, which are seemingly very different particles, nonetheless have *exactly* the same electric charge. A proton is seen to be simply a neutron that has lost a single electron, leaving it with an extra positron. And the electron is not "created" as it leaves the neutron; it was there all along.

Moreover, it would seem to admit of the possibility that energy, special conditions, and catalysis might synthesize neutrons at low temperatures, possibly explaining some or all of the neutrons, transmutations, and excess heat produced in cold fusion.

This model must, however, address the *spin* of the neutron. T.E. Phipps Jr. (1976, 1986) also suggests a model of the neutron made of electron-positrons, but his model runs into difficulty with the neutron, which has a spin of *l/2h,* just like the electron and positron. But if one has equal numbers of electrons and positrons, each with opposite and canceling spins, the resulting neutron should have spin 0, whereas it of course has spin 1/2, like all of the fermions.

But this reflects current physics' tendency to regard the spin of the electron as somehow not a "real" spin, but a "pure quantum effect," as Bohr liked to call it. But we have shown above that it can indeed be regarded as a real spin, with real angular momentum, if one regards it as a *complex* spin, having angular momentum in one or more "imaginary" directions as well as its c^2 spin in "real" directions.

Moreover, some 90% of the epos that make up the "Sirag model" have 0 spin, being pure one-dimensional vibrations in imaginary directions. The remaining 10% share "real" angular momentum, mostly canceling, which must, overall, amount to spin 1/2. But as this is a "real" spin, there is nothing to say that a "real" extended neutron with the large "real" mass of some 1838e is not "really" spinning with a "real" angular momentum of 1/2A. In order to obey Fermi-Dirac statistics, it must have this half-integer angular momentum, but it is not necessary to assign that spin to an individual electron or epo constituent when it can simply be a property of the extended neutron itself.

The Strong Nuclear Force

However, the prime merit of this model has to be its representation of the strong nuclear force. Here we need to note a strange coincidence: the mass of the proton, in electron-masses, is roughly the same as the strength of the proton's strong force, in electron-forces. (Mass of proton: 1836 electron-masses. Strength of the electromagnetic force: the "fine structure constant" $a = e^2/hc = 1/137$; strength of strong force: $g^2/hc = -15$. Ratio: -15 x 137, somewhere around 2000 [Shankar, 1994].)

Thus the ratios of the masses and of the forces are roughly the same, "around 2000." This is a major clue to the nature of the "strong force."

Gravitation and the Coulomb force both have simple inverse square "shapes" that operate over long distances. Theoretically, at least, they never drop to zero. However, the shape of the strong force between nucleons is radically different and very peculiar. Up to a distance of around a fermi (10-15 m _y is very strongly repulsive, keeping the nucleons apart. Then, for no apparent good reason, it changes abruptly to very strongly attractive, then drops off very rapidly, so that at a distance of around three fermis it becomes immeasurable. This peculiar shape has never been successfully modeled by any theory.

Note how current theory, in which the fudge is an accepted scientific procedure, "solves" this problem. Since current theory can't model this *observed* force, it simply ignores it, and instead invents (fudges) an *unobserved* (fifth!) force carried by eight "gluons" *(designed to be unobservable)* between eighteen or thirty-six "quarks" *(also designed to be unobservable)* inside the nucleon. It then "suggests" that this fudged gluon force in some unspecified way "leaks out" of the nucleon to make up the peculiar shape of the measured strong force. However, our "epo model" of the nucleon models this very peculiar shape simply and intuitively.

Because of the uncertainty principle, the nucleon, with its measured diameter of around 1.9 fermis, can not be a perfect sphere, but must be a pulsating spheroid. However, the epos that make it up have "asymptotic freedom"—they vibrate individually, and each lepton is free to form a relationship with any available antiparticle. This means that, as two nucleons approach each other, at a distance of about three fermis, electron-positron pairs will begin to form, not just within the nucleons, but between them. (Pairs of "intemucleon" epos would have to form at the same time, keeping the total number of paired charges in each nucleon at 9180.) This would cause a strong, short-range attraction between the nucleons as more and more pairs formed. This would increase to a maximum at around 1.5 fermis, after which it would rapidly turn into a strong repulsion (since the individual epos have to

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After fifty or so years of effort, the huge physics establishment admittedly has failed utterly to provide a model that comes close to matching that peculiar shape of the nuclear force. Yet Dirac's equation provides a model that fits like lock and key.

maintain their average 1.87 fermi separation), keeping the nucleons a stable distance from each other.

Moreover, a maximum of 918 such "internucleon" pairs could form, the number vibrating in the direction joining the two nucleons, one-tenth of the total. This would give the interaction the strength of 1836e, and exactly explain the *strength* of the strong force, "about 2000 times as strong as the Coulomb force" (Shankar, 1994).

Now, what is the chance that a completely wrong model of the nucleon would exactly match both the strength and the very peculiar shape of this most individual of forces? After fifty or so years of effort, the huge physics establishment admittedly has failed utterly to provide a model that comes close to matching that peculiar shape of the nuclear force. Yet Dirac's equation provides a model that fits like lock and key.

Dirac's Theory of Everything

This model simply, intuitively, and clearly explains the *size* of the nucleon, the *mass* of the nucleon, the very peculiar *shape* of the strong nuclear force, the *strength* of the strong nuclear force, and the strange fact that the very different proton and electron have charges of *exactly* the same strength. *No other model explains any of these features, including the very cumbersome "Quantum Chromodynamics" of the SM.*

The neutron thus constructed is the source of electron, proton, and neutron in their very anomalous abundances, hence of all stable matter in the universe. This makes the amounts of matter and antimatter in the universe *exactly equal,* as experiment demands, and as no other model provides. We saw earlier that the "electromagnetic field," "the photon," and the *P wave are all epo manifestations necessary for the stability of the BEC. So we have complete closure: the BEC "must" be produced by the Dirac "zeroth quantum field." For its stability, it in turn "must" produce our universe, using only the particles called for by the Dirac equation, which as we can now see *predicts* that the entire universe is made from just these four kinds of electron.

Einstein spent much of his life trying to unify the "four forces." We have shown that the "strong nuclear" force is nothing but electromagnetism. Moreover, the "weak nuclear" force has since been unified with the electromagnetic in the "electroweak" theory (Weinberg, 1967; Salam, 1968). This leaves only gravitation. Puthoff (1989, 1993) suggests that gravitation is a residual effect of the ZPF of the vacuum electromagnetic field, *i.e.* a residual effect of electromagnetism. Again, however, this paper suggests a different structure and origin for the ZPF. Moreover, Puthoff's gravitation is "pushing together" gravitation, similar to LeSage's "ultramundane corpuscles," whereas the other negative-energy forces act by "pulling together." We suggest a model on the lines of these other "pulling together" (negative-energy) forces, which also utilizes a residual effect of electromagnetism.

Magnetogravitation

Dirac's equation predicts that the magnetic moment of the electron should have a value of *eh/2m.* This is the magnetic moment balanced by the BEC, attaching every unbalanced charge to a charge of opposite polarity, thus bringing the BEC back into balance. As shown above, however, the presence of unlimited numbers of epos and their associated photons give Dirac's value a tiny unbalanced correction, multiplying Dirac's value by 1.0011596522, the 'g' factor. This figure represents the best agreement between theory and experiment in all of science.

As a consequence, every electron has a tiny unbalanced magnetic moment at the same phase of its cycle. Since time is quantized, every electron will reach this phase of its cycle at the same instant. For its stability, the BEC must balance this tiny imbalance as well. It can only do this by initiating one extra epo chain. This epo chain will have far less induced strength than the other, balanced chains, since it is induced by this feeble unbalanced magnetic moment rather than the powerful Coulomb force. However, *it cannot connect anywhere,* since every electron has the same unbalanced moment at the same phase angle. (So does every positron, at the opposite phase angle.) Thus these feeble epo chains will simply extend into space, connecting at one end to every electron and positron (hence to all "real" matter), but being unconnected at the other end. However, these unconnected chains, extending into space, will cause a tiny unbalanced attraction between all matter. Since the number of chains per unit area of space will decrease as $1/r^2$, it is evident that this tiny unbalanced attraction has the form of gravitation.

Moreover, this "magnetogravitation" reacts to changes in mass instantaneously (or at least in time r.) This explains why the Earth and Sun don't form a "couple," and why the Earth "feels" gravitation from the Sun at the Sun's instantaneous position, rather than its retarded position, as is shown by astronomical observations (Van Flandem, 1998).

This model of gravitation solves many problems with other models, including numerous experiments which seem to show that gravitation can be shielded, contrary to Newtonian gravitation and General Relativity (Majorana, 1930; Allais, 1959; Saxl, 1971; Jeverdan, 1991, and Van Flandern, 1998). In a careful ten-year series of experiments, Majorana demonstrated that lead shielding between the Earth and a lead sphere measurably lessened the weight of the sphere, while shielding above the sphere had no effect. This would seem to support "pulling together" gravitation and to disprove "pushing together" models such as LeSage's, Van Flandern's, and Puthoff's. Allais, Saxl, and Jeverdan carefully observed the behavior of various kinds of pendulum during different solar eclipses. All three pendulums exhibited major anomalous behavior at the onset of totality, indicating that the moon strongly interfered with the gravitational connection between the Earth and the Sun at that time. This provides major evidence for our "epo chain" model of gravitation.

Further analytical work will have to be done to verify that this tiny unbalance, which *must happen,* has the force as well

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> The negative energy "sea" and its effects, which collectively may be termed "the aether," is virtually undetectable, and offers no resistance to the motion of "real" objects.

as the characteristics of gravitation. If this hypothesis is correct, all of the matter and all of the forces in the universe are seen to be the result of just these four kinds of electron, fulfilling Dirac's unitary dream.

Inertia

Inertia, however, has been a riddle ever since Foucault showed that his pendulum responded, not to any local frame of reference, but apparently to the frame of the "fixed stars." This became the basis of Mach's principle, which states that the "fixed stars," or (since they aren't fixed) the "sum total of mass in the universe," somehow reaches out to affect pendulums and gyroscopes. (And somehow knocks you down when the subway starts suddenly). Though this "action at a distance" appears to violate causality, and its apparently fixed frame of reference violates relativity's ban of any such fixed frame, Einstein set out to incorporate Mach's principle into relativity. In the end, though, he had to admit he was not successful.

Haisch, Rueda, and Puthoff (1994) made a very plausible case that inertia is a residual effect of the ZPE. They were not, however, able to quantify the effect. As this study presents a rather different picture of the ZPE, the question is worth another look. To go along with the "kinetic theory of mass-energy," we present what might be called the "kinetic theory of inertia." (Or possibly the "gyroscopic theory of inertia.")

A gyroscope establishes a vectoral plane of angular momentum. Any change in the angle of that vectoral plane is strongly resisted. As shown by Dirac's equation, an electron has a circular vibration in two "real" directions, giving it a "real" energy of me^2. However, it also retains its (negative energy) vibration at $+c$ in an "imaginary" direction. Thus its oscillation is circular but complex, having both a "real" and an "imaginary" component, and giving it the anomalously large angular momentum of *tt/2* in any "real" direction.

This makes the electron a little gyroscope. However, since this vibration is complex, part "real" and part "imaginary," this angular momentum plane can not point in any "real" direction, as is also the case with the orbital electron's angular momentum vector, as mentioned above.

This means that acceleration in any "real" direction must act to change the angle of the electron's (complex) angular momentum vectoral plane and thus will be resisted with a force equal to and in a direction opposite to the acceleration, and proportional to the electron's "real" mass-energy.

Dirac's "Operator Theory" or "Transformational" version of QM represented the wave function as a vector rotating in phase space. This "kinetic theory of inertia" represents a vectoral plane rotating in a complex space. How this results in inertia can be seen by looking at the wave function T that represents a particle with definite momentum. The length (value) of the complex number 'P is the same at all positions, but its phase angle increases steadily in the direction of the particle's motion, the x direction, making it a complex helix in shape.

The rate of this complex rotation in its axial (x) direction is the measure of the momentum. As x increases by a distance of *h/p,* this phase angle makes one complete rotation (Taylor, 2001). Increasing the momentum (an acceleration in the "real" x direction, increasing p), acts to decrease the distance *h/p,* on the exact analogy of a coiled spring being compressed. (QM represents momentum as a spatial sine wave or helix.) However, since T is a complex number, acceleration in the (real) x direction increases the pitch of this complex phase angle and so is resisted by the electron-gyroscope. This compression acts to store the energy added by the acceleration according to the Lorentz relationship. Compressing the distance *h/p* to zero would require (and store) infinite energy. (One might picture this complex helical oscillation as the particle's flywheel, storing energy as it is accelerated.)

Since the complex gyroscope-electron *must* resist an acceleration in any "real" direction, what can this resistance be but inertia? And since this resistance must be proportional to its "real" mass-energy (that rotating in "real" directions) it would seem to meet all of the criteria. It is also simpler and more intuitive than any other, depending solely on the undeniable fact that the electron's rotation is *complex.* We suggest that any time a QM relationship includes *i* (and most of them do) the resulting function will only be explained by reference to these extra dimensions.

We have shown that all stable matter, and arguably all matter, is compounded of electron-positron pairs with large "imaginary" components, so that all matter would exhibit this "gyroscopic inertia" in proportion to its "real" mass-energy.

Note that this is a *local* model of inertia, depending on the fact that the spins of all "real" particles are *complex,* extending into extra dimensions. Thus it eliminates the magic actlon-at-a-distance of Mach's principle, in which the "fixed stars" somehow reach out across light-years to knock you down when the subway starts suddenly. It further explains why only "real energy" particles, with complex spins, have inertia, hence mass. Negative energy epos, and also the positive-energy epos that make up the electromagnetic field, have one-dimensional vibrations, hence no vectoral plane, hence no mass or inertia. This is why the negative energy "sea" and its effects, which collectively may be termed "the aether," is virtually undetectable, and offers no resistance to the motion of "real" objects.

The "Neutrino"

Several matters remain to be explained, however. The first is another question of spin. The neutron is a spin 1/2 particle, obeying Fermi statistics. So is the proton, and so is the electron. Therefore, in Beta decay, to conserve angular momentum the neutron must get rid of this half unit of spin, ft/2, as well as of a random amount of "real" energy. (This energy is the difference between the mass/energy of the neutron and the sums of the mass/energies of the proton, the electron, and the momentum energy of the ejected electron. It is a random amount because the electron emerges with a spread of velocities.) Fermi invented a "particle," the "neutrino," on the model of the "photon," to take away this spin and energy. (Now called the "antineutrino" by modern convention.)

However, like the "photon," the neutrino has no charge, and

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therefore violates our kinetic definition of energy. But as the electron emerges from the neutron, it is immediately surrounded by polarized epos, and these can absorb "real" angular momentum. However, absorbing this spin makes the epo a "spin 1/2 boson," which is unstable. It must immediately pass on the spin the way the "photon" (epho) passes on the "spin 1" energy, forming a "neutrino wave" on the model of our "photon wave" of polarized epos, which would travel at signal velocity. However, no "real" electron can accept 1/2 unit of spin, so the (anti)neutrino wave must continue on indefinitely, until it meets with rare and exceptional conditions such as one in which an electron and a proton can combine with it to re-form into a neutron. (Such conditions are not so rare in a star.) It is the detection of such rare interactions as this which have been proclaimed the "discovery" of the "neutrino." Thus the "neutrino" is no more a separate particle than is the "photon."

The Antineutron?

We must deal with one further difficulty. We have suggested that a vorticular storm in the BEC seems to be the source of the neutrons which, ejected into our four dimensions, have produced the stable matter of "our reality." However, vortices come in "left-handed" and "right-handed" versions. Presumably, a "left-handed" vortex would produce only "left-handed" neutrons, and expel them into our reality. But what about a "right-handed" vortex? It would presumably produce "right-handed" neutrons (antineutrons) which decay into antiprotons and positrons. (Particle accelerators produce both kinds.) These would form "antihydrogen" and presumably antioxygen, anticarbon, and the rest. Is it possible that there are places in our reality where "right-handed" vortices have produced whole galaxies of antimatter? At first sight this seems quite possible, as from afar an antimatter galaxy would be indistinguishable from one made of matter. However, it also seems unlikely that any nearby galaxies are antimatter, as one would think that sooner or later matter and antimatter must meet and "annihilate," which would produce floods of easily-detectable 0.511 MeV photons, which are not in evidence.

There are at least two more possibilities. First, the BEC may be separated into a "northern hemisphere" and a "southern hemisphere." On our planet, the vortices we call "hurricanes" or "typhoons" rotate exclusively counterclockwise in the northern hemisphere and clockwise in the southern. This would place a "great gulf" between the matter galaxies and the antimatter galaxies, so that they would seldom or never meet. (Astronomers have mapped several such "great gulfs" or "voids" around 200 million light years across in which few or no galaxies are found. If such a gulf separated matter galaxies from antimatter galaxies, there would be no "annihilation," hence no means of distinguishing an antimatter galaxy.)

Alternatively, the BEC may in some unknown fashion act as a "sorting device," sending only "left-handed" neutrons to our reality, while expelling "right-handed" neutrons into a reality on the *"other side"* of the BEC. Presumably this would be into four *more* ("imaginary") dimensions, which would also have a positive-energy balance, but would be made of antimatter. Perhaps in the future we will find that for some reason the BEC must act as a sorter to "left-handed" and "right-handed" universes. Or, alternatively, we may find that only "left-handed" vortices are possible. However, there seems to be no way at present of choosing between these possibilities, and there may be more. The important fact is that, locally at least, we get only left-handed neutrons from the BEC; otherwise we would have no net positive energy balance.

Other important matters remain unexplained. The 9180 pairs of epos in the neutron must perform an elaborate ballet in the form of a ten-dimensional vortex. Mathematical analysis of this elaborate dance is needed, which should show why this structure is slightly unstable, while the proton's similar dance, performed with one "empty chair," is apparently completely stable. It should also show why this stability is extended to the neutron, when it joins in the even more elaborate dance of the compound nucleus. (Neutron and proton apparently "change places" during this dance, so that the "empty chair" feature is shared between them, possibly offering a hint to this stability.)

A study of condensation offers further clues to this stability. Ninety percent of the epos in a neutron vibrate in imaginary directions at any one time; therefore the neutron has a large negative energy balance, and could be said to be poised on the verge of condensation.

(The following argument is adapted from Taylor [2001].) Take a sample of liquid helium containing a macroscopic number of atoms, N. Cool it until it approaches a state of minimum energy. It then has a wave function Ψ_N. Since this depends on the individual states of all N atoms, it is a very complicated function. If we now examine a sample containing N + 1 atoms, it will have a wave function $_{+1}$, depending on N + 1 states. By comparing $_{+1}$ with Ψ_N, one can define a function *f(x)*. This depends on just one state x, the position of the "extra" atom. This *f(x)* represents the *order parameter,* and allows the sample to condense, as it defines the quantum amplitude for adding one extra entity. Thus in the condensate this *f* fixes the order of the every helium atom, breaking the symmetry to give the entire condensate the same, arbitrary phase angle, hence the same wave function. The loss of a single electron, in the case of the neutron, would give the resulting proton an extra positron, which might similarly define its order parameter, making it a totally stable condensate.

If this model is correct, this analysis should also yield exact agreement with the experimental values of the magnetic moment of the neutron and proton, which are lacking in the SM. Moreover, analysis of the proton *as a condensate* should explain many of the scattering results, which now are obscure. It should also eventually be possible to model all of the unstable particles revealed in cosmic rays and particle accelerator collisions as fragmentary, temporary associations of epos. (We note that the binary is the base of *all* number systems, and suggest that any particle that seems to require combinations of three-based quarks can also be modeled using binary epos. The quark is a noble effort at order and simplicity—it simply is not basic enough.)

However, the model also makes predictions that should have readily measurable effects in the macrocosm. Those effects should manifest themselves wherever there are large numbers of ions, which force the BEC to extraordinary lengths to balance this instability in its midst. These large numbers of ions are called plasmas.

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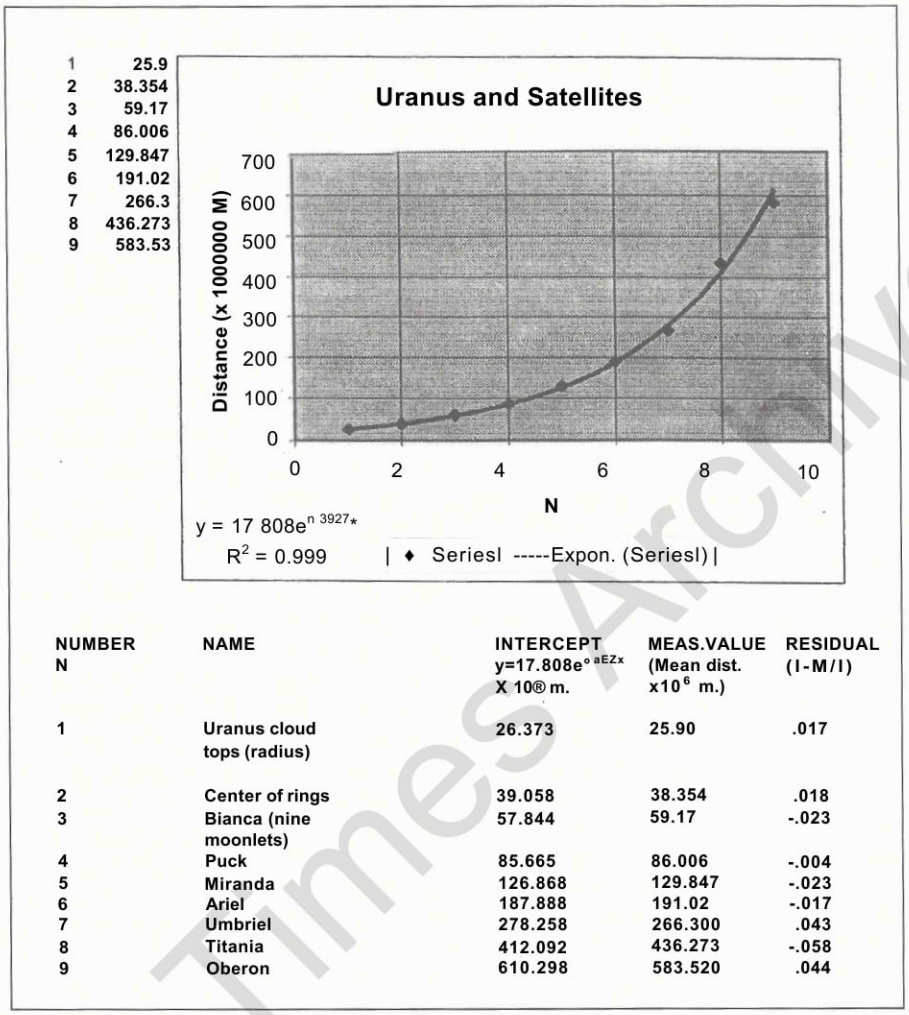
Plasmas

David Bohm's early work at Berkeley Radiation Laboratory included a landmark study of plasmas (Bohm, 1980, 1987). To his surprise, Bohm found that ions in a plasma stopped behaving like individuals and started acting as if they were part of a larger, interconnected whole. In large numbers, these collections of ions produced well-organized effects. Like some amoeboid creature, the plasma constantly regenerated itself and enclosed all impurities in a wall in a way similar to the way a biological organism might encase a foreign substance in a cyst. Similar behavior has been observed by Rausher (1968), Melrose (1976), and others, and is now a commonplace of plasma physics. However, no one has ever explained how a collection of ions can act in concert. *But this is exactly the behavior of one of our BECs, formed in the laboratory at temperatures near 0°K and consisting of an aggregation of bosons.*

Any BEC must have an exact balance of positive and negative charges. An ion can't be tolerated, and must be expelled by the BEC. It is suggested that the above behavior of a plasma is not because *it* is self-organizing, but because the universal BEC can't tolerate a collection of unbalanced ions, and so organizes this irritation into a plasma "pocket" of least irritation, tending toward a spherical form. This plasma pocket acts, in some ways, as if it were itself a BEC. The organization exhibited is because some of its attributes, ordered and controlled by the BEC, are governed by a single wave function.

Our hypothesis is that *any* aggregation of plasma will behave to a certain extent as a single unit, acting as if self-organizing, because, since it is intolerable to the Big BEC, it is isolated as a body, organized by the BEC, and thus partially governed by a single wave function. Since the wave function is determined by the BEC, whose components vibrate only at c, the period of the wave function would necessarily be, for a spherical plasma pocket, its light-diameter. This is according to Hamilton's Law of least action also, as in quantum theory the longest-wavelength vibration will have the least energy. Thus the light-diameter vibration will be the stable, least energy one.

The largest collections of plasmas in our vicinity have to be the Sun and the gas-giant planets. All of them have



NUMBER N	NAME	INTERCEPT y=17.808e° aEZx X 10® m.	MEAS.VALUE (Mean dist. x10⁶ m.)	RESIDUAL (I-M/I)
1	Uranus cloud tops (radius)	26.373	25.90	.017
2	Center of rings	39.058	38.354	.018
3	Bianca (nine moonlets)	57.844	59.17	-.023
4	Puck	85.665	86.006	-.004
5	Miranda	126.868	129.847	-.023
6	Ariel	187.888	191.02	-.017
7	Umbriel	278.258	266.300	.043
8	Titania	412.092	436.273	-.058
9	Oberon	610.298	583.520	.044

Figure 4. Uranus and satellites.

anomalies, mysteries we can't explain. Regularities in the spacing of the satellites of these planets have long been noted, and ascribed vaguely to "resonances," though resonances *of* ■*what* has never been specified. Celestial mechanics, based solely on gravitation, has never been able to account for them. For one thing, resonances are invoked to explain the "Kirkwood *gaps"* in the spacing of asteroids in the "belt" between Mars and Jupiter. These are periods in which no asteroids are found, and which occur at harmonics (1/2, 1/3, etc.) of the period of Jupiter. However, some of these harmonics have a clumping of satellites, rather than a gap. And the three inner Galilean satellites of Jupiter are locked into near octave harmonics, with periods within 0.0036 of a 1::2::4 ratio, and there are other octave relationships in the satellites of Saturn. A gravitational "resonance" can't explain both a gap (an *instability')* and a *stable* relationship at the same harmonic ratio, so some other factor must explain one or the other.

There is a very strange unexplained anomaly in the cases of the gas giants and their satellites. The semi-major axis of our Moon's orbit is some 30 Earth diameters, whereas the innermost satellites of these gas giants orbit no more than one or two diameters of the primary from these giant dynamos. With the Earth and the Moon, tidal forces slow the Earth's rotation and force the Moon ever further from us.

However, Jupiter's moon Io orbits only 3.5 Jupiter diameters away. Tidal forces on Io are strong enough to wrack the satellite, making it the most volcanically active object in the solar system. Why haven't these fierce tidal forces long since moved Io far away from its primary? It can not be a new satellite, as Io exhibits profound differences from the other Galilean satellites, indicating that these powerful tidal forces have wracked Io for many millions of years. Yet instead of having been moved away by these tidal forces, as required by celestial mechanics, it seems locked immovably in place, a mere three and a half

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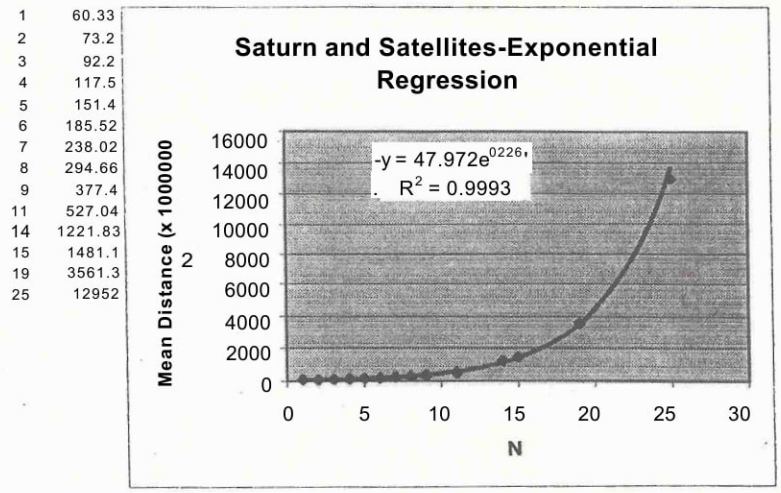

NUMBER N	NAME	INTERCEPT Y=47.972e^{0226*} x 10^6 m.	MEAS.VALUE (Mean dist. x 10^6 m.)	RESIDUAL (I - M / 1)
1	Saturn cloud tops (radius)	60.137	60.330	-.003
2	'C' ring	75.386	73.200	.029
3	Inner edge 'B' ring	94.502	92.200	.024
4	Outer edge 'B' ring	118.46	117.50	.008
5	Epimetheus, Janus	148.5	151.4	-.020
6	Mimas	186.16	185.52	.003
7	Enceladus	233.37	238.02	-.020
8	Tethys, etc.	292.54	294.66	-.007
9	Dione, Helene	366.73	377.40	-.030
11	Rhea	576.29	527.04	.085
14	Titan	1135.26	1221.83	-.076
15	Hyperion	1423.1	1481.1	-.041
19	Iapetus	3514.4	3561.3	-.013
25	Phoebe	13638	12952	.050

Figure 5. The spacing of Saturn and its satellites—exponential regression.

Jupiter diameters away. *It must be held in place by some force even more powerful than the powerful tidal force,* a force totally unexplained by celestial mechanics.

It has further been noted that the spacing of the satellites of these gas giants seems to follow a distribution similar to "Bode's Law" for the planets, though this defies explanation, given these immense tidal forces (Miller, 1938; Richardson, 1945; Ovenden, 1972; Spolter, 1993.) Our new understanding of Dirac's equation, however, does offer an explanation. These giant spinning bodies of plasma are organized by the BEC and therefore have a single wave function. They are charged bodies spinning in an ocean of charge, and must set up standing waves in that ocean.

For it has never before been remarked that the *first term* of the "Bode-like" distribution, in each case, is the *equatorial radius* of the rapidly rotating body of plasma that makes up the gas giant planet. (See Figures 4, 5, and 6.) The wave function governing the spinning body of plasma necessarily has a node at the surface of the planet. By Schrodinger's equation, however, that wave function would not be limited to the planet itself, but would extend, with greatly attenuated ($1/r^2$) amplitude out from the planet, forming a (longitudinal) standing wave. Everywhere but at a node, the waveform has amplitude, and would act to "polarize the vacuum." (It would raise in state epos from negative to positive energies, polarizing them to point in "real" directions.) But because the waveform caused by the spinning plasma "polarizes the vacuum" everywhere but *at* a node, this "vacuum polarization" would add amounts of energy to any matter (dust, gas, asteroids, etc.) *not* at a node, nudging the matter towards a node. There it would collect over millions of years, like sand on a tapped drum head, forming rings of material, which eventually would collect into one or more satellites. These nodes would necessarily be at harmonics of the planet's radius. Its satellites, unless they are new captures in transition, or disturbed somehow, should orbit at these nodes.

This is exactly what is shown in Figures 4, 5, and 6, for Uranus, Saturn, and Jupiter. Mean distances (semi-major axes) of the satellites are from the *Astronomical Almanac* for 1996. Since the rapidly spinning gas giants are notably oblate, the top of clouds (equatorial radius) is used as the first node.

These systems match the exponential regression curves with R^2 (coefficient of determination) values ranging from 0.9978 to 0.9993. (A statistician would say that R^2 is a measure of the proportion of variation in *y* that can be explained by the regression line using *x*. The remainder is the percentage attributable to chance, "chaos," or to other variables.) This indicates that *at least* 99.78% of the value of the semi-major axis, the satellite's orbital position, can be attributed to the function of the x-value, its (quantum) period number. This leaves rather little (from 0.07% to 0.22%) to chance or to other variables.

In nature, such (quantum) periodicity is exhibited *only* in the normal modes of wave behavior. Therefore we can say with some certainty that each of these three figures constitutes a *wave signature,* as clear and definite as the well-known Airy pattern that they resemble. And since the wave clearly originates with the gas-giant planet, as *explained* by the sea of charge required by the Dirac equation, the wave's *existence* can be considered confirmed. Moreover, it is clearly more powerful than the powerful tidal forces. (With Jupiter, something else is also going on. We will discuss this later.)

This would seem to be the clearest kind of evidence for this requirement of the Dirac equation. Each of the figures demonstrates that a *wave of polarization,* at least 99.78% determined by its normal mode period number, originates with these spinning bodies of plasma. That *all three* show the same wave behavior would seem to eliminate all further doubt. Moreover, as is to be expected, the inner satellites of each planet, where the wave function would have the largest amplitude, fit best.

The only selection involved in these figures is in the rings, in which small chunks of matter are evidently disintegrating under extreme tidal forces and evolving from one node to another. (Neptune, the other gas giant, is not included. It shows evidence of some major disturbance that stripped it of Pluto and Charon, its former satellites

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1	71.4
2	100.5
3	181.3
4	221.9
5	421.6
6	670.9
7	1070
8	1883
12	11100
12	11480
12	11720
12	11740
13	21200
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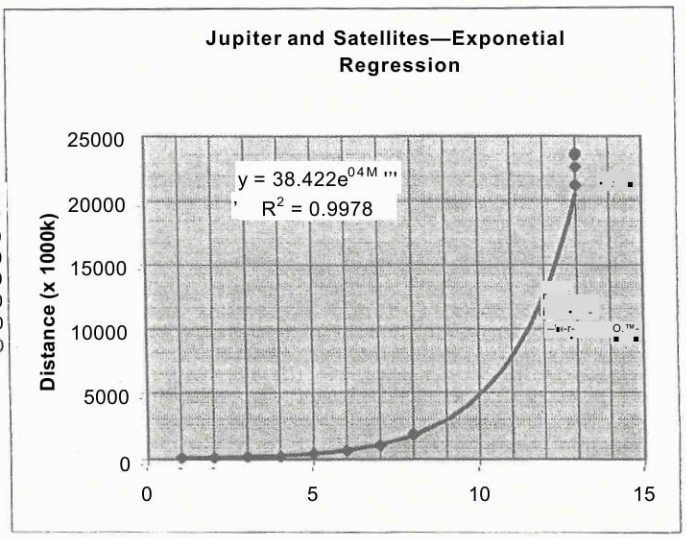
13	23500
13	23700



NUMBER (N)	NAME	INTERCEPT Y=38.422e	MEAS.VALUE X 10⁵ meters	DIFFERENCE (I—M 71)
1	Jupiter Radius	62.3	71.4	-.146
2	Center of Rings	101.0	100.5	.005
3	Amalthea	163.7	181.3	-.107
4	Thebe	265.3	221.9	.164
5	Io	430.0	421.6	.020
6	Europa	697.1	670.9	.038
7	Ganymede	1130	1070	.053
8	Callisto	1832	1883	-.028
12a	Leda	12647	11100	.122
12b	Himalia	12647	11480	.092
12c	Lysithea	12647	11720	.073
12d	Elara	12647	11740	.072
13a	Ananke	20500	21200	-.034
13b	Carme	20500	22600	-.102
13c	Pasiphae	20500	23500	-.146
13d	Sinope	20500	23700	-.156

Figure 6. The spacing of Jupiter and its satellites—exponential regression.

[Van Flandern, 1993]. Its present clearly disturbed system exhibits only a limited regularity).

The figures show the best fit value in terms of a power of *e,* base of natural logarithms. The powers reduce to 1.253 for Saturn, 1.480 for Uranus, and 1.621 for Jupiter. That the satellites regularly fall at harmonics of the planet's diameters is clear. Why nodes fall at those particular harmonics, which are different for each planet, seem to be related to the planets' diameters, hence the periods of their fundamental wave functions. We will discuss this further at a later time.

That we live in an ocean of charge, of which we are as little aware as a fish in an ocean of water, will be difficult for many to accept. Even more difficult to accept is the above proof that a planet such as Jupiter is the source of a standing wave that has amplitude millions of kilometers from its surface. Despite our preconceptions, though, waves in this ocean of charge, as required by Dirac's equation, would seem to be confirmed beyond all reasonable doubt by the above correlations.

Moreover, studies have shown that the planets, particularly Venus and Jupiter, have a pronounced affect on the electron densities in the Earth's ionosphere, the effect peaking when these planets are close to the Earth (Harnischmacher and Rawer, 1981). The authors had no explanation for this effect, so it took considerable courage to publish their findings. But the above standing waves of polarization exactly account for this effect. Venus is the planet that comes closest to us, and Jupiter is a powerhouse whose standing wave affects all of the planets. *This means that wave functions, harmonics, beats, and interference will ultimately prove to be as important in the macrocosm as they are in the quantum world.*

However, by far the largest body of plasma in our system is the Sun, with over 99.7% of the system's mass. What of *its* standing waves?

The Sun

By the argument used with the gas giant planets, the planets of the solar system should fall on nodes that are harmonics of the Sun's radius. (In the Sun's case, we will demonstrate that these harmonics are *octaves,* powers of 2.) But the gas giant planets are far from the Sun and rotating very rapidly, so that their waves of polarization are the strongest influence on their satellites, as shown in Figures 4, 5, and 6. The solar system, however, is dynamic, changing with time. The Sun is an energetic furnace that exports angular momentum to the planets, as the Nobelist Hannes Alfven (1981) first demonstrated.

This is the principal, supposedly conclusive argument that is advanced by conventional astronomers against such attempted correlations as Bode's Law. They say the positions of the planets must change with time, so any correlation at present would not have been so in the past, and will not be so in the future, and therefore must be coincidence.

The Sun exports angular momentum by means of the solar wind, the Sun's magnetic field, tidal forces, and radiation pressure. All of these transfer angular momentum from the Sun to the planets, both slowing the Sun's rotation and increasing the planets' distances from the Sun. Together, at least for the inner planets, these forces are clearly stronger than the polarization caused by the Sun's wave function. Therefore, all of the planets out to Jupiter have over billions of years been moved from their original octave positions. This is one reason for the seemingly anomalous distribution of angular momentum in the solar system, in which the planets, notably Jupiter, have much more angular momentum than the "parent" body. (This may not have been the case in the early solar system, when the Sun was rotating much faster, as the strength of this wave function would seem to be a product, among other factors, of the velocity of rotation of the body of plasma.)

However, Ovenden (1972) with his "least interaction action" calculations,

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showed that interactions between the planets serve to keep them in approximately equal spacing. Thus the planets, as they evolved from original octave positions, would maintain their approximate spacing, so that their present positions show the roughly regular spacing indicated by Bode's Law, the limit of which is the original octave relationship. (See Figure 7, a logarithmic plot of the solar system.)

The principle argument by conventional astronomers is that, because the solar system is dynamic, Bode's Law must be coincidence. However, because Ovenden's "least interaction action" keeps the spacing regular, at *any time* during their evolution from octave positions, the planets would have formed a "Bode-like" configuration, merely with different coefficients. So this argument fails. (We will later suggest a further factor which might act to keep the spacing of the planets regular. We will further show that though these inner planets have retreated from their original octave positions, they all now orbit on another harmonic node.)

Planets inside of Mercury either have been vaporized by the Sun, or never managed to gather into a planet. Mercury itself keeps "one foot" in the original octave position, its perihelion distance falling at the original octave node, and its travels through higher amplitude regions of the wave function might, as we will see, account for the excess rotation of its perihelion without recourse to "curved empty space." (An oxymoron, as Phipps [1986] pointed out.)

However, Saturn, Uranus, and Pluto remain at the original octave positions. (See Figure 7.) The mean diameter (semi-major axis x 2) of Saturn's orbit is within .0035 of 2^{11} times the diameter of the Sun, that of Uranus is within .0025 of 2^{12} times that diameter, and that of Pluto is within 0.035 of 2^{13} times that diameter. (Since the diameter of the Sun is somewhat imprecise and seems to vary by about 300 kilometers over the course of the 11-year cycle [Gilliland, 1981] these octaves can be considered "exact.")

Neptune, as Van Flandern (1993) shows, was the victim of some energetic event, probably a collision or "close encounter" with some major body, which, we propose, caused it to lose sufficient angular momentum so that it dropped into its present (non-octave) position. This freed its satellites Pluto and Charon to continue around the Sun with the approximate semi-major (octave) axis of the original Neptune, with their added orbital angular momentum (which was originally around Neptune) throwing them into their present eccentric orbit. Pluto then captured Charon as its satellite.

Kepler's Universal Harmony?

Quantum theory treats everything as *wave* at all times, except for a measurement situation, which no one understands. Both the Schrodinger and the Dirac equations are *wave equations.* We predicted above that wave functions, harmonics, beats, and interference will ultimately prove to be as important in the macrocosm as they are in the quantum world. However, since time is quantized, the important harmonics should be harmonics of t, that quantum of time. We live in an ocean of

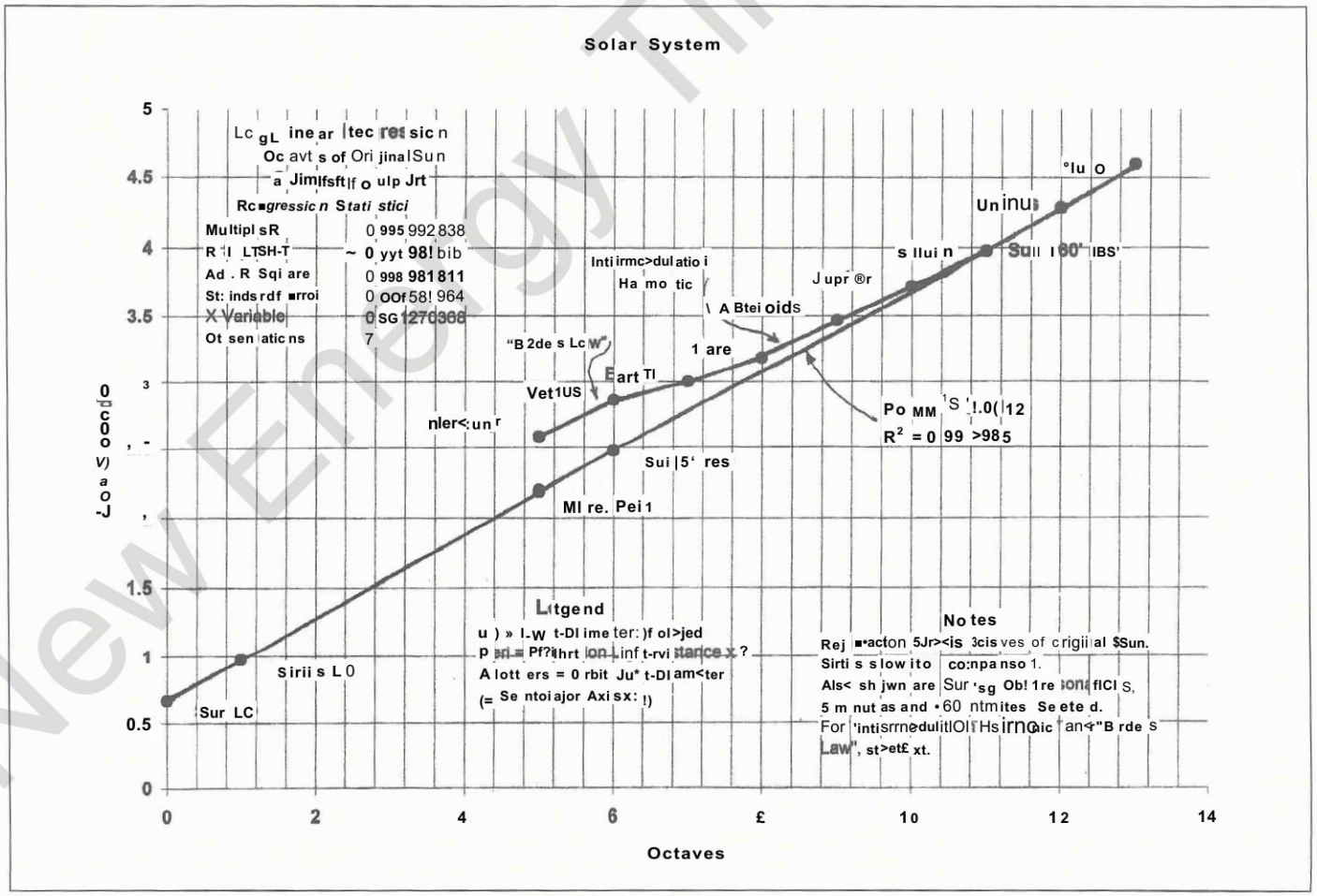

Figure 7. Solar system spacing.

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charges vibrating at that quantum beat. Therefore the harmonics, particularly the octaves (powers of 2) of that beat should, by Hamilton's law, be the least-energy configurations of energetic bodies, particularly bodies of plasma, in the macrocosm. *Every energetic body of plasma should act, in some ways, as a quantum object.* And the quantum object it resembles, as we will show, is the BEC, which organizes its wave function. However, the nucleon, which makes up about 99.97% of the universe's mass, is a structure that vibrates in ten dimensions. Therefore the harmonics of 10t should be nearly as important.

Moreover, there is a time, $h/m_e c^2$, equal to 8.09 x 10^{-21} seconds, that Heisenberg considered to be the "fundamental time" (Heisenberg, 1936, 1938a, 1944). In 1925, when Einstein recommended de Broglie's theory of matter waves to his thesis committee, he suggested that the inverse of this time, $m_e c^2/h$, be considered a universal electromagnetic limit frequency. And this time is within 1% of 10r x 2^7, another indication that octaves of 10r should be important.

It has been objected that harmonics of quantum objects can not be projected to macrocosmic dimensions because small errors would be so magnified as to lose all accuracy. However, since time is quantized, and since we live in an ocean oscillating at that frequency, the exact harmonics would be reinforced all along the way, with the least-energy configurations tending to minimize any such errors. An example is the resonance between two of the hyperfine levels of the cesium atom, used in the atomic clock because of its rock-solid stability. This frequency, which defines the international second, is within 0.005 of being an exact octave of r (6.26 x 10^{-24} s. times 2^{44} = 1.101 x 10^{10} s. The period of the cesium resonance, 1/9 129 631 770 Hz, is 1.095 x 10^{40} s.) This gets us over half way to the macrocosm without notable loss of accuracy.

The second thing we note is that the mean light-diameter of Jupiter, the second most energetic body in the solar system, is also almost an exact octave of this quantum of time. (This would be the period of its wave function.) Since Jupiter is notably oblate, the mean diameter is based on its volume: D = $2(3V/4n)^{1}/3$.(Mean diameter of Jupiter = 139,193 km. Light-diameter = 0.46432 s. x x 2^{76} = 0.47299 s. or less than 2% different.) Equally remarkably, the diameter of the Sun (1,391 80 km.) is, to 5 significant figures, *exactly* 10 times the mean diameter of Jupiter. And the diameter of just one star has been measured with any accuracy. That star is the blue giant Sirius, the brightest star in the sky, which has been repeatedly measured by stellar interferometer. *By the average of its measurements, its diameter is 2.04 times the diameter of the Sun, its light-diameter within 0.0013 of 10xx2^{77}*, an almost exact octave both of 10r and of the Sun's light-diameter. Other stars have also been measured, but the probable errors of these measurements are so large that one can only say at present that it *looks like* their diameters *might* all be harmonics of x or of 10t. Much more refined measurement techniques are now possible; however, astronomers appear to shy away from such measurements. Could they be afraid of what they will show? We predict that *all* measurable stars will prove to have light-diameters that are harmonics of x with octaves of x and 10r predominating.

We need to deal here with two objections sure to be raised to these figures. It has been objected that the "light-diameter" of a massive body could not be important, because the velocity of light in a body such as the Sun would be very different from that in a vacuum: $c = 1/(\mu_o \varepsilon_o)^{1/2}$. Light in a massive body slows, depending on its permittivity and permeability. However, the wave function is determined by the BEC, in which the wave always travels exactly at c_{max}. The above wave functions of the gas giant planets support this; and we will present further evidence to this effect in what follows.

Second, it has been objected that figures based on octaves, beats, and harmonics

Table 1 Solar System Correlations
Exponential Regression

Jupiter (r) Series

ITEM	RELATION	OCTAVE	N	INTERCEPT (SECONDS) R^2 = 1 Power=1.99936	MEAS. VALUE (SECONDS)	RESIDUAL (I - M / I)
T ($2e^2/3mc^3$)	rX2^n	1	0	6.2517 X 10^{24}	6.262 X 10^{24}	-.002
Proton	Light-diam.	1	0	6.2517X 10^{24}	6.2 x 10^{24}	.008
Atom Clock	Cesium res.	2^{44}	44	1.0844 x 10^{10}	1.0953 x 10^{10}	-.010
Jupiter	Light-diam.	2^{76}	76	0.46101	0.46432	-.007
Mercury	Aph. Lt.-dist	2^{85}b	85	235.360	232.493	.012
Mercury	Sid. Period	2^{110}	100	7 675 348	7 600 520	.010
Earth	Sid. Period	2^{102}	102	3.0682 X 10^7	3.1558 X 10^7	-.029
Mars	Sid. Period	2^{103}	103	6.1344 X 10^7	5.9355 X 10^7	.030
Pluto	Sid. Period	2^{110}	110	7.8344 x 10'	7.8374 x 10'	-.001

The term 'Light-diameter' refers to the time in seconds that it takes light to cross the object. The 'Light-diameter' of a xc object is of course ***x***. With Mercury the 'Peri. Lt-dist' is the time light takes to travel from the sun to Mercury at its perihelion position; x 2. 'Aph. Lt-dist' is the same at its aphelion position.

Sun (10r) Series

ITEM	RELATION	OCTAVE	N	INTERCEPT (SECONDS) R^2 = 1 Power=1.9999	MEAS.VALUE (SECONDS)	RESIDUAL (I - M / 1)
10r	10xx2^n	2^0 = 1	0	6.2517 x 10^{23}	6.262 x 10^{23}	-.002
Heis.Fund.T.	"h/m c^2"	2^7	7	8.0126 x 10^{21}	8.0904X 10^{21}	-.010
Sun	Light-diam.	2^{76}	76	4.7135	4.6432	.014
Sirius	Light-diam.	2^{77}	77	9.4265	9.4721	-.005
Mercury	Peri. Lt.-dist.	2^{81}	81	150.79	152.77	-.013
Sun	"5-min. res."	2^{82}	82	301.57	299 ±3	.008
Sun	"160-min.res."	2^{87}	87	9647.9	9600 ± 30	.005
Saturn	Light-diam.	2^{87}	87	9647.9	9520.0	.013
Uranus	Light-diam.	2^{88}	88	19 294.9	19 153.6	.007
Pluto	Light-diam.	2^{89}	89	38 587.8	39 451.6	-.023
"Io Shout"	Radio noise	2^{90}	90	77 172	76 426	.009
Io	Sid. Period	2^{91}	91	154 336	152 853	.009
Europa	Sid. Period	2^{92}	92	308 656	306 815	.005
Ganymede	Sid. Period	2^{93}	93	617 281	618 105	-.002
Venus	Sid. Period	2^{98}	98	19 748 065	19 414 000	.016
Neptune	Sid. Period	2^{106}	106	5.0535 x 10^9	5.2004 x 10^9	-.029

Note: Sirius and "Io Shout" shown for reference—not used in regression. "Light Diam" for Saturn, Uranus, and Pluto is the time light takes to cross its mean orbit. (Semimajor axis x 2).

'Heis. Fund. T.' is the 'fundamental time' (h/m jproposed by Heisenberg (1944).

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"sound like numerology." This is a favorite ploy to discount numbers we don't like—as if there were something wrong with numbers, or as if we could present and collate data other than numerically. Numbers we like are "data"; numbers we don't like are "numerology." However, as noted above, almost the only place in physics where whole (quantum) numbers appear is in the normal modes of wave behavior. But we also have indicated, and will demonstrate in what follows, that all physics is quantum physics, since all matter is *wave,* and therefore all physics devolves ultimately to the (quantum) normal modes of wave behavior. Ultimately, therefore, all physics is "numerology."

With this in mind, a quick look through the *Nautical Almanac* reveals a host of periods or resonances of macroscopic objects that are almost exact octaves either of x or of lOx. *Every body of the solar system has a major period that is within a few percent of an octave either of* x or of lOx. (This period is either the light-diameter of the object, the light-diameter of its orbit, or its sidereal period.) Many have more than one octave value. The sidereal period of Earth, for instance, falls within about half a percent of an octave of x ($6.26 \times 10^{-24} \times 2^{102} = 3.174 \times 10^{7}$ seconds; sidereal period of Earth = 3.156×10^{7} seconds. Difference = 0.57%). The farthest from an octave is Mars, whose sidereal period falls a fat 6% from an octave value. However, Mars, as we will see, falls much closer to another, stronger harmonic.

This result beggars coincidence. The resulting regression statistics (see Table 1 and Figures 8 and 9) for both x and lOx have R^2 values of better than 0.999999, meaning that there is no question that the figures are related, and related to their (quantum) period numbers, which are octaves, powers of 2. Again, this is the clearest possible *wave signature.*

With a range of 110 octaves, the exponential regression charts are meaningless, so we have shown logarithmic linear regressions both of the entire range (Figures 8 and 9), and of the range covering only the solar system (Figure 10, which shows both regressions over the range of the solar system). Taken in any detail or combination, the R^2 values of better than 0.999999 show that the octave relationship is unquestionable, with the possibility that the relationship is chance being less than 1 in 1,000,000. Moreover, the "Sun series" and the "Jupiter series" remain almost exactly parallel, exactly an order of magnitude apart, throughout their entire ranges. There is a slight divergence from a power of 2 in both regressions (on the order of 1.9995) which is probably not significant, indicating merely that in the upper reaches of the regression the bodies are far away from the source of the harmonic wave.

It seems evident that when the inner planets were forced out of their initial octave positions by the angular momentum transferred from the Sun, they moved relatively rapidly to the next nearby harmonic. (By Kepler's third law a planet whose period is an octave of x or lOx would have a light-diameter that is also a harmonic, though not an octave.) They could "defend" this harmonic position for a longer period, before being forced to the next harmonic. This would seem to be why most of the planets not still at octave

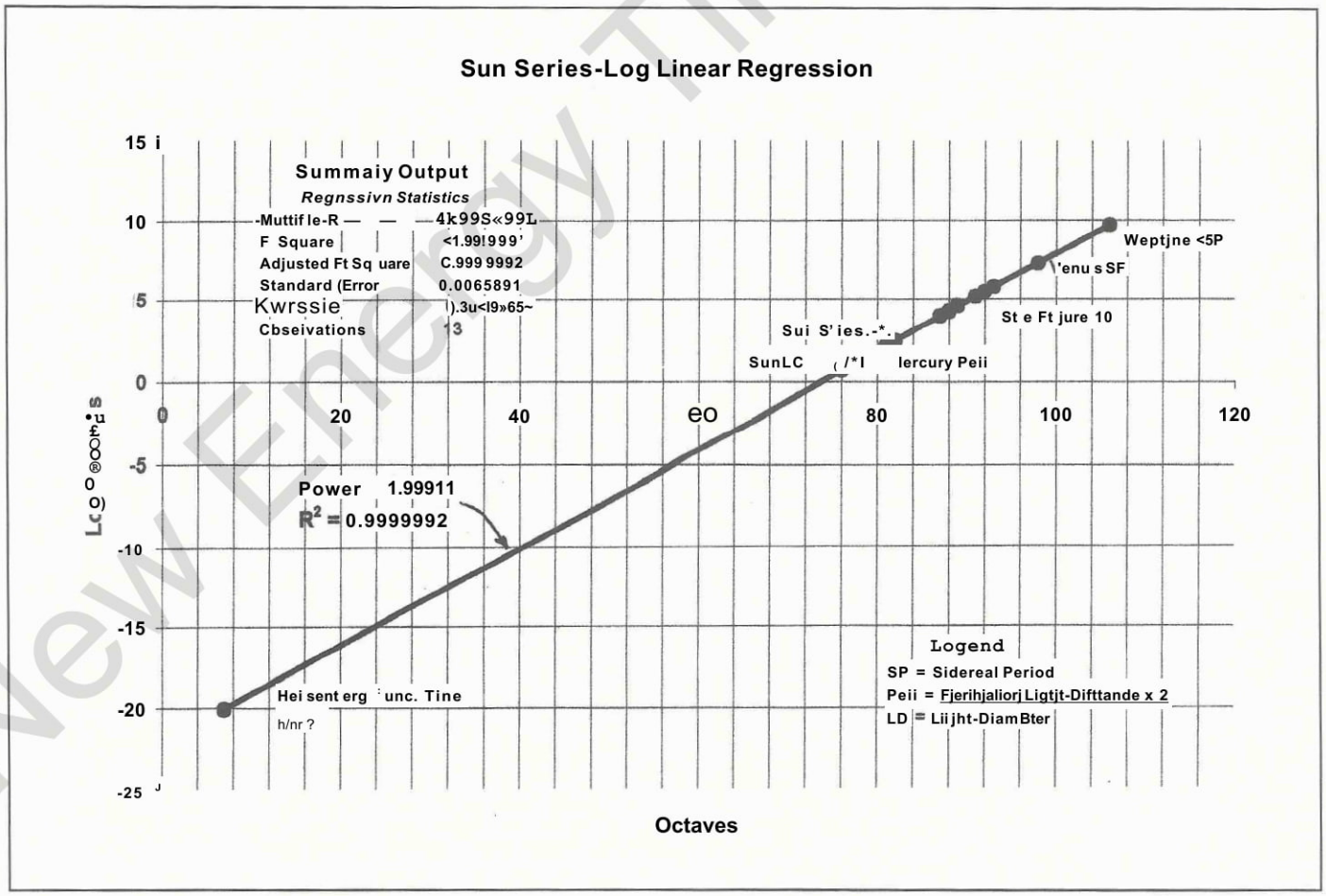

Figure 8. Sun series—log linear regression.

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distances have octave periods.

However, Jupiter is the powerhouse of the planets. It has the most angular momentum, both rotational and orbital, and its harmonic is the primary, the T harmonic. It is noteworthy that the plane of the ecliptic is roughly the plane of *Jupiter's* orbit. The Sun rotates a full 7° away, and only nearby Mercury orbits over the Sun's equator, with Venus splitting the difference with an inclination of 3.4 degrees.

Moreover, the Sun's export of angular momentum stops at Jupiter. The outer planets orbit, apparently undisturbed, at their original octave distances. But Jupiter has moved to an apparently unassailable position, the *intermodulation harmonic* between its r harmonic and the Sun's 10r beat. (Its orbit's light-diameter is within a percent of (r + 10r) x 2^{86}.) Moreover, there apparently is a "back-eddy" of this intermodulation beat that affects the next two inner periods, the asteroids and Mars. Those asteroids which remain orbit where Jupiter permits them. The average mean orbit light-diameter of the ten largest asteroids is exactly at 12r x 2^{85}, the intermodulation beat. And Mars, next in, is within 2% of 13r x 2^{84}, which apparently also allows it to be near an octave period harmonic. (Jupiter's t harmonic. See Table 1.) (Yes, this "sounds like numerology" again. But once we acknowledge that we live in an ocean of charge, then waves, beats, interference, and harmonics become *data,* not numerology.)

Mercury is a fascinating case. We mentioned that it keeps "one foot" at its original octave position—its perihelion light-distance is within less than a percent of 10r x 2^{80}, the Sun's octave. Yet its aphelion distance is within a couple of percent of r x 2^{84}, Jupiter's harmonic. Like a good quantum object, it oscillates between the Sun's harmonic and Jupiter's harmonic. Meanwhile its sidereal period is within 1% of yet another octave, r x 2^{100}. No wonder all the angular momentum exported from the nearby Sun can't budge it from its position—it is locked into three separate harmonics.

This would appear to solve a long-standing problem concerning Mercury. The dynamics of a small body orbiting close to a large body tend to remove the eccentricity from the small body's orbit and place it on a node of its standing wave. The Galilean satellites of Jupiter, for instance, have eccentricities ranging from 0.002 to 0.009—they are in perfectly behaved, almost perfectly circular orbits. The inner satellites of Saturn have even less—Tethys has a measured eccentricity of 0.00000. By contrast, Mercury, closest to the Sun, has by far the most eccentric orbit (0.2056) of any planet, if you exclude Pluto, which is probably an escaped satellite of Neptune. But like the cesium atom's resonance between two hyperfine levels, the Mercury quantum object resonates between two harmonics while orbiting on a third.

Table 1 requires some further comment. The Sun has two measured global resonances—a well-known "5-minute" resonance, and a "160-minute" resonance measured independently by two different teams of astronomers (Brooks *et al.,* 1976; Severny *et al.,* 1976). Their findings have been replicated by Scherrer and Wilcox at Stanford and by a French-

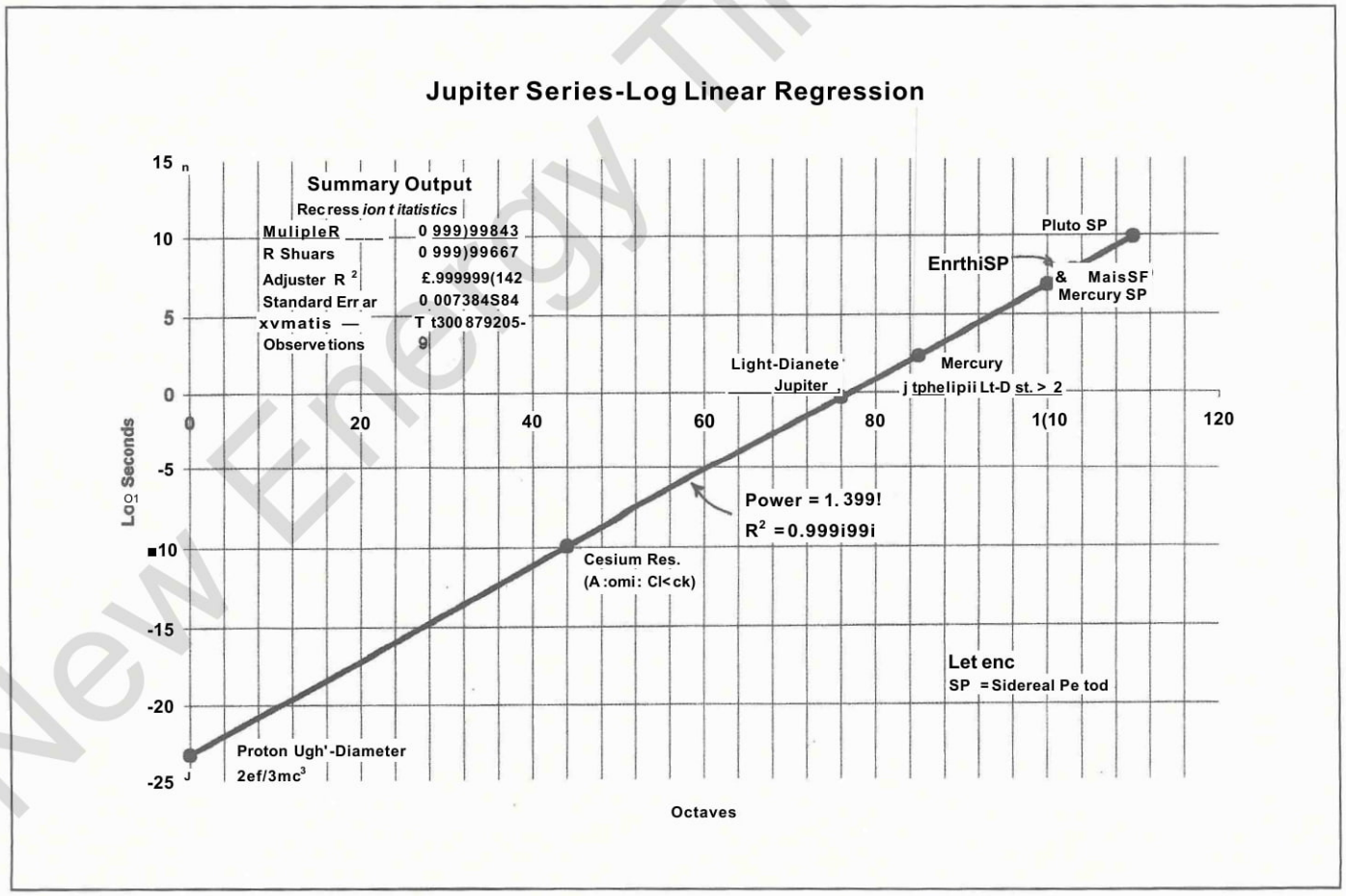

Figure 9. Jupiter series—log linear regression.

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> Time and again we find scientists saying, in effect, "These are the theories on which I base my facts." This is what the Churchmen told Galileo. Discounting measured data because it disagrees with a theory is the antithesis of science.

American team (van der Ray, 1980) and the "160-minute" solar resonance shown to be stable over more than 1400 periods. The Russian group tracked the oscillation for more than four years. However, this resonance has been discounted and ignored because it does not fit the standard solar model. Time and again we find scientists saying, in effect, "These are the theories on which I base my facts." This is what the Churchmen told Galileo. Discounting measured data because it disagrees with a theory is the antithesis of science. As it turns out, both of these global resonances are exact octaves of each other and of the light-diameter of the Sun. (Light diameter of Sun = 4.6432 s. x 2^6 = 297.2 s. 5 m. = 300 s. Diff. = 0.009. 5 x 2^8 = 160). This has never before been noted, probably because of the above mentioned fact that light does not travel at c_{max} inside the Sun. However, these global resonances are direct evidence for our hypothesis that a body of plasma's wave function is set by the BEC, which always vibrates at c_{max}.

Moreover, these global solar resonances are interesting from another standpoint, one having to do with the Jovian system. We have noted the power of Jupiter, with all its angular momentum—that it can reach down and impose its harmonics even on Mercury. Yet, as shown in Table 1, the three inner Galilean satellites, mere flies on the face of Jupiter, nonetheless have sidereal periods that are octaves of the Sun's 10r harmonic! This startling result demands an explanation, especially as we have earlier seen that these three satellites' semi-major axes fall on an exponential regression with Jupiter's radius as the first term.

One answer, of course, is Kepler's third law. So long as the satellites maintain ratios of distances that are powers of about 1.6, as Jupiter's satellites do, their periods will have ratios that are roughly powers of two, as $1.6^3 \approx 2^2$. (The actual ratios with these three satellites are 1.5913 and 2.0074, which of course exactly obey Kepler's law.) The remarkable thing, which we will examine, is that these ratios are *exactly* the same between Io and Europa as between Europa and Ganymede.

The other unanswered question, of course, is how these periods "just happen" to fall on exact octaves of the Sun's harmonic. The period of Io, in particular, is within half a percent of 2^{15} times the Sun's light-diameter.

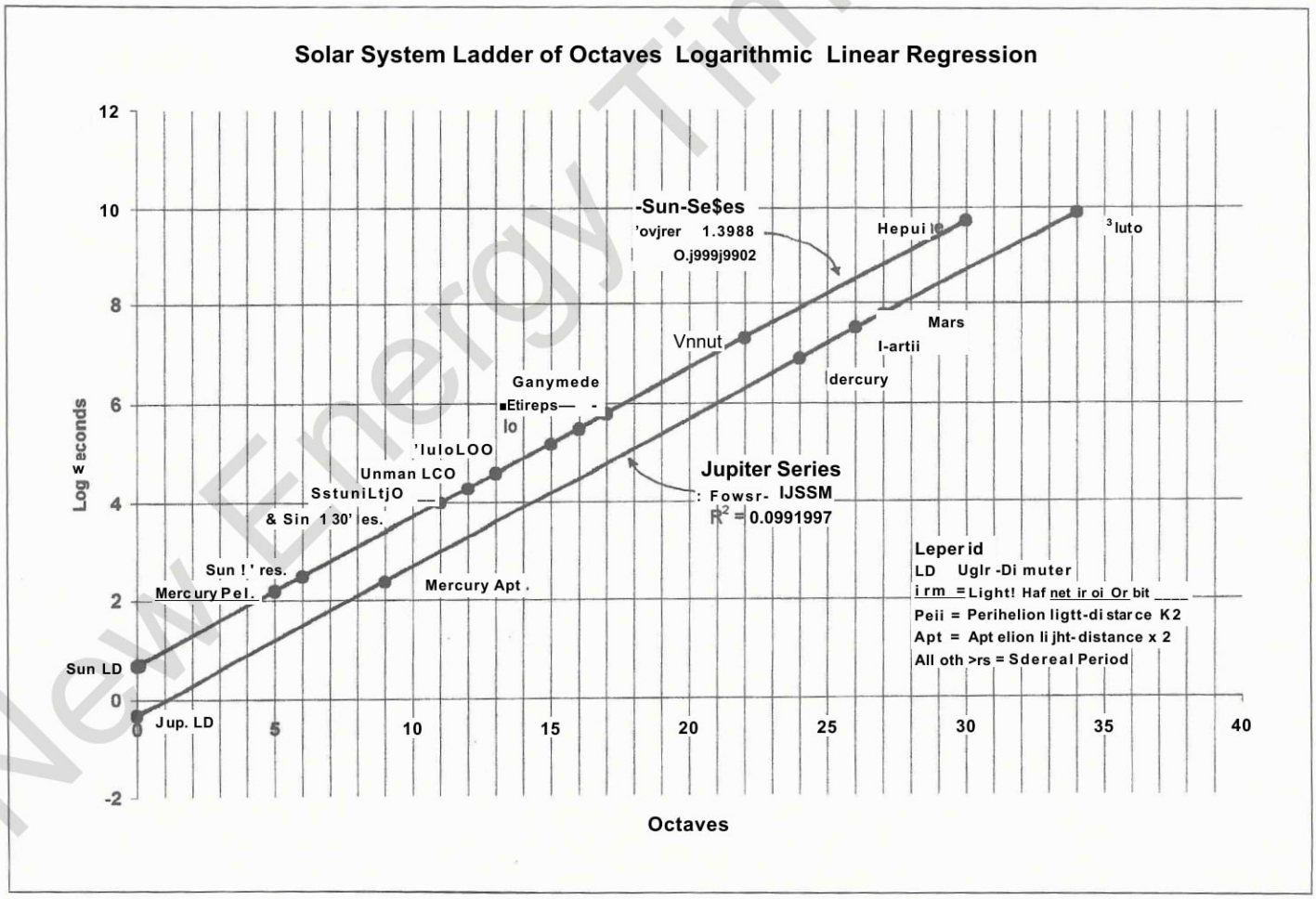

Figure 10. Solar system ladder of octaves logarithmic linear regression.

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Io is perhaps the most unique body in the solar system. It is connected to Jupiter by a "flux tube" of electrons conservatively estimated to be 5 million amps at 400,000 volts or more than 50 times the combined generating capacity of all the nations of Earth. Yet this immense power still accounts for less than 1% of the power dissipated by Io! This power is literally ripping Io apart, making it the most volcanically active object known. Sulfur ions spewed forth by these volcanoes form a torus in the shape of lo's orbit. And whenever Io, Jupiter, and the Sun form a right triangle, Io emits an immense burst of radio synchrotron energy with a power greater than 5000 times the combined generating power of all the nations of Earth *(Time-Variable Phenomena in the Jovian System,* 1989). This report in summary concluded that among the anomalies they can't presently account for are ", . .dramatic short-term changes in the Jovian system, including changes in the Galilean satellites' orbits, geology, and geophysics, and the planets' internal structure." For one thing, they have measured the periods of these satellites accurately to nine significant figures, only to find, the next time they measure them, that they are different in the sixth or even the fifth significant figure.

These short-term changes in the Galilean satellites' orbits seem to be connected to lo's explosive burst of radio noise which occurs whenever the three bodies reach a right angle relationship, the angle between the electric and the magnetic fields. This explosion is called, in Table 1, the "Io Shout." It is *synchrotron* energy, directed along the tangent of lo's path as it reaches elongation: thus, once every period of Io, it is directed in a cone more or less exactly at the Sun. As noted, this occurs on an exact octave of the Sun's harmonic. What happens to a resonant body when it is energized by a vibration exactly at its resonant frequency? Surprise: it resonates. Positive feedback, like the public address system squeal. This might begin to explain the Sun's two global resonances, both octaves of the Sun's harmonic, both octaves of the "Io Shout," both largely or totally unexplained by conventional solar theory. (This "Io Shout" takes about 43 minutes to reach the Sun. It is a prediction of this theory that the "Io Shout" and the 160-minute global resonance should be *in phase,* when this 43 minute lag is taken into account. Someone with access to the raw data should check this.) Moreover, the 160-minute resonance has been shown to vary greatly in its amplitude (Severny *et al.,* 1966) and this has led to some of the doubts about its existence. But this amplitude variation is exactly what we would expect if it is related to the strength of the variable "Io Shout."

Another factor to be taken into account is the inclination of Jupiter. Io rotates almost exactly above Jupiter's equator, but Jupiter's 3.12° inclination would cause the effect of the "Io Shout" to vary in intensity throughout the Jovian year, reaching a maximum as the inclination passes the ecliptic every six Earth years or so.

But there is more to the story. Despite these dramatic short-term changes in the Galilean satellites' periods, the *relationship* between the periods remains the same, that found by Laplace. He studied this relationship, calling it a "three-body orbital resonance" and showed that the mean orbital motions N_{lz} N_2 and N_3 are connected by the equation

$$Nj - 3N_2 + 2N_3 = 0$$

The net effect is that, when two bodies are in conjunction on one side of Jupiter, the third is always on the other side. This, however, hardly begins to explain what is going on here. What, exactly, is resonating, in this three-body resonance? How was it set up, how is it maintained, through millions of years in the heart of Jupiter's intensely energetic system? With the noted short-term changes in these satellites' periods, what maintains this resonance? No one has ever been able to explain dynamically how such a system could come into being, or connect it to Jupiter's gravitation or spin.

For the relationship shown in Laplace's formula to occur, the three inner planets must reach successive conjunctions at elongation (relative to the Sun) in some period of time, keeping in mind that one planet will always be on one side of Jupiter, the other two on the other side. Let's start our timing at one of these conjunctions. For a conjunction to recur at the same elongation, say between Ganymede and Europa, there must be some whole (quantum!) number of Ganymede's periods *n* such that $f(n) = 2n + 2$, in other words that Europa must have made *exactly* $2n + 2$ revolutions while Ganymede made *n.* Such a relationship, implied by Laplace's formula, could hardly be coincidence; it would mean that they were truly synchronous, only on a much longer period than the simple 1::2::4 ratio already noted. Is there such a number *n?* There is indeed; and it turns out to be the highly interesting number 137, the inverse of the electronic Fine Structure Constant *a.* (This constant is a pure number, not exactly 1/137, but 1/137.0359722. Eddington tried to derive it from the numbers 1 and 136, used in our "Neutrosynthesis," but of course this was dismissed as numerology.)

Conventional astronomers claim that the only force operating between the planets is gravitation, but since we have shown that gravitation is a residual effect of electromagnetism, we can now confidently state *that the only force operating between the planets is electromagnetism.*

What is the ratio of the electronic Fine Structure Constant doing in the fine structure of the ratios of Jupiter's satellites? Well, we have shown above that there *is* only one force, the electromagnetic. Conventional astronomers claim that the only force operating between the planets is gravitation, but since we have shown that gravitation is a residual effect of electromagnetism, we can now confidently state *that the only force operating between the planets is electromagnetism.* Moreover, we have shown above that waves of polarization with amplitudes millions of kilometers from the gas giant planets operate to move their satellites into the normal mode nodes of those waves.

No one knows where the electronic fine structure constant comes from anyhow. Feynman (1985) calls it "the *greatest* damn mystery in physics." As the Nobelist Lederman (1993) says, "The fine structure constant. . .[a]. . .can be arrived at by taking the square of the charge of the electron

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divided by the speed of light times Planck's constant. . .this one number, 137, contains the crux of electromagnetism (the electron), relativity (the velocity of light), and quantum theory (Planck's constant)." He notes that Heisenberg and Pauli were obsessed by this "137" mystery, and that Feynman suggested that all physicists should put up a sign in their homes or offices to remind them of how much we don't know. The sign would read simply: 137. (Lederman chose this number as his home address.) However, if "everything is electromagnetism," it is no more (or no less) mysterious to find the electronic fine structure constant in the fine structure of the ratios of Jupiter's satellites than it is to find it in the fine structure of the atom, and another indication that this unitary thesis is correct.

The Jupiter system appears to be a *generator,* extracting immense amounts of energy from the BEC by what seems to be a three-octave tuned resonance tuned to the Sun's harmonics. It would seem to hold clear clues as to how we might extract this energy.

In any case, if $n = 137$, $f(n) = 276$; $f(276) = 554$. It looks like this:

Ganymede:	137 per. x 7.1546631 days/per.	=	980.18884 days
Europa:	276 per. x 3.5511431 days/per.	=	980.11550 days
Io:	554 per. x 1.7691614 days/per.	=	980.11543 days

After less than three years, all three line up again *at elongation,* although one is on the opposite side of Jupiter from the other two. Ganymede trails 3.7 degrees behind, but Io and Europa arrive at elongation within *six seconds* of each other. Six seconds in three years is better timekeeping than the original Atom Clock, an error of 1 part in 14 million. (Of course, these periods change almost daily, as noted above, and another set of periods will find Ganymede catching up to the others. These numbers are from the 1976-77 *Handbook of Chemistry and Physics,* but every edition has different values for these periods. When calculated as above, however, all of them average to 980.14 days.)

There is also an out-of-phase series of elongations, the 2n + 1 series, based on 137/2, when Ganymede reaches its elongation at the opposite side of Jupiter:

Ganymede:	137/2 per. x 7.1546631 days/per.	=	490.09442 days
Europa:	138 per. x 3.5511431 days/per.	=	490.05775 days
Io:	277 per. x 1.7691614 days/per.	=	490.05771 days

Whenever one of the other satellites arrives at elongation at the same time as Io, the "Io Shout" is orders of magnitude more powerful. However, as Jupiter orbits around the Sun, these conjunctions at elongation will occur at different angles relative to the Sun. Only once in every eight 490-day periods will the conjunctions of all three planets occur with Io at elongation with its synchrotron energy pointing directly at the Sun. (Of course, a whole series of near-conjunctions will occur leading up to and trailing away from this time.) And eight 490.07 day periods amount to 10.73 years. Could this have something to do with the Sun's 11-year sunspot period? If the Sun's global resonances are caused by the Io Shout, which peaks in intensity every 10.73 years, there would indeed seem to be a connection. More study, in conjunction with Jupiter's inclination, will be necessary to answer this question.

However, we seem to see the outlines of a "harmonic cycle" here, analogous to the terrestrial "oxygen cycle" and "nitrogen cycle," and so forth. The orbiting planets cause tidal and other disturbances in the Sun. The Sun's export of angular momentum (necessarily on its lOt harmonic) seems to be required for its own stability, to push these disturbing factors further away. Jupiter, with its immense magnetic field, absorbs large amounts of this 10r energy. However, it has achieved stability on the intermodulation harmonic between its -t energy and the Sun's 10r energy, and can't absorb any more angular momentum in its orbit, so all of this angular momentum must go to increase Jupiter's already enormous rotation, or it must be dissipated somehow. The Jupiter-Io-Europa-Ganymede system seems to act as an enormous generator—and dissipator—of 10r harmonic energy, much of which is thrown back at the Sun, completing the cycle.

Earlier we left unanswered the question of why the harmonics of the gas-giant planets were factors of 1.25 for Saturn, 1.48 for Uranus, and 1.62 for Jupiter. We have since seen that the Jupiter system's diameters must have a factor of around 1.6 for its satellites' periods to have a factor of 2, and resonate with the Sun's octave harmonics. There may be a harmonic reason as well for the other two factors. Since their light-diameters are not octaves of x, they must "beat" with x. Saturn's factor is 5/4 (1.25). 5/4 times the mean light-diameter of Saturn is within 1.5% of the nearest octave harmonic ($x \times 2^{76}$). Uranus's factor is approximately 3/2 (1.48); similarly, 1.48 times the mean light-diameter of Uranus comes to within 5% of the nearest x octave harmonic, $x \times 2^{75}$.

Anomalies

Dirac's equation, followed logically, requires space to be a "plenum" rather than a "vacuum." It is a BEC full of vibrating charges. Moreover, this universal BEC is sensitive to every slightest change in ionization, instantly adjusting to maintain its own integrity. As we have seen, there is clear and overwhelming evidence that rotating bodies of plasma such as the Sun and the gas giant planets set up standing waves in this sea of charge which have physical effects on any matter they encounter. This would indicate that the present celestial mechanics, computed using only gravitation, could *not* accurately account for the behavior of bodies anywhere but at nodes of these standing waves. And this means that any body *not* at a node *must* have small anomalies in its celestial mechanics. As we will see in what follows, there do appear to be anomalies that seem qualitatively to account for these necessary discrepancies. Since we can't yet quantify the standing wave, the anomalies can not be considered proof of this hypothesis. However, if such anomalies were not present, this would constitute *disproof* of the hypothesis. Therefore it is important to look at them.

The Solar Corona

Since the planets between Mercury and Jupiter no longer orbit at nodes which are octaves of the Sun's diameter, we would expect there to be sizable anomalies near the Sun and with the inner planets, with their amplitude diminishing at roughly $1/r^2$ with distance from the Sun. And with the Sun itself we have a major indication that our hypothesis makes sense. For while the surface of the Sun is a "cool" 5800°K or so, the surrounding corona has temperatures that routinely reach 1,000,000°K. The corona is *expanding from* the surface, and by the gas law should *cool* as it expands. How can the expanding, cooling exhaust be 170 times hotter than the furnace? This is regularly called "the greatest problem in solar physics." All kinds of answers have been proposed,

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magnetic "pinching" being the latest, but none comes within orders of magnitude of the energies required. However, if, as shown above, the Sun's surface is the node of a powerful macrocosmic polarization wave, it is easy to understand that the node would be relatively cool, while anything flowing away from the node into areas of higher amplitude would be excited to high temperatures. And of course we would expect this effect to be strongest closest to the Sun, and to diminish in amplitude at roughly $1/r^2$ away from the Sun.

The Planets

There are minor but persistent anomalies in the celestial mechanics of each of the inner planets, starting with the well-known one at Mercury. (The Mercury anomaly is roughly explained by GR, but none of the others are.)

Newcomb (1897) calculated, and Doolittle (1912) confirmed, that the celestial mechanics of three planets yielded anomalous differences with measurements that were very much greater than could be attributed to errors. The first anomaly was the celebrated advance of the perihelion of Mercury, for which Newcomb calculated a difference between observed and computed values of 41.24 ± 1.35 seconds of arc per century. For this the GR correction is 42.98", or not quite within the probable error (computations are from Spolter, 1993). The second anomaly, the motion of the node of Venus, Newcomb gives as 10.14 ± 1.86 seconds of arc per century. GR gives no correction whatever for this anomaly. The motion of the perihelion of Mars is the third anomaly. Newcomb calculates it to be 8.04 + 2.43 seconds of arc per century. The GR correction for this is only 1.35", which is only about 17% of the measured advance.

If GR is the final answer to gravitation, and gravitation is the only force operating between the planets, GR should provide answers to *all* of these anomalies. And there are other reasons for suspecting that GR may not be the final answer, primarily because space appears to be Euclidean at every scale, and "curved empty space" is a contradiction in terms, as Phipps (1986) observed. Also, the "Magnetogravitation" outlined herein seems to be a simpler and more elegant answer, but does not in itself explain the advance of Mercury's perihelion.

However, the advance of Mercury's perihelion, Newcomb also calculated, could be explained by a local modification of the force of gravitation from the inverse square to the inverse (2 + e) power, where e is a small number of about 10^{-7} (Van Flandern, 1993). *Such a local modification of the force of gravitation is exactly what would be required by our hypothesis that the Sun is the source of a macrocosmic vacuum polarization wave.* In fact, since Mercury is only on a node of the Sun's octave wave at its perihelion position and travels through regions of high activity the rest of the time, it must be said that if Mercury's perihelion did *not* experience such an advance, it would disprove our hypothesis. And while we can't yet quantify it, the above modification is qualitatively in the right direction and seems reasonable for such a force at the distance of Mercury.

Furthermore, a large polarization of the vacuum in the vicinity of the Sun would necessarily cause a refraction (bending) of light passing near the limb of the Sun, and so might explain another of the supposed proofs of GR. (The corona itself also causes such a refraction, which was not taken into account in the supposed proofs of GR in 1919.)

Both Venus and Mars would be expected to have measurable anomalies in their celestial mechanics, as Newcomb found. These anomalies can not be explained either by GR or by conventional celestial mechanics. Both planets are caught between the powerful polarization waves of Jupiter and the Sun. However, we noted above that the plane of the ecliptic is roughly the plane of *Jupiter's* orbit, with only Mercury orbiting above the Sun's equator, 7 degrees away. However, Venus, with a 3.4° inclination, is caught half way between these influences, and this might explain the otherwise puzzling motion of its node.

This effect, with the Earth, might be expected to reveal itself in how well the planet observes Kepler's third law. It should now be possible to measure even tiny discrepancies using radar, laser, and spacecraft ranging observations. Since the ranging observations are considerably more accurate than the old optical data, astronomers now set the size of the Earth's orbit by these ranging (distance) observations, and then use Kepler's third law to compute the Earth's period. However, according to Van Flandern (1993) a small but significant discrepancy persists with the optical data, which insists that the Earth's period is about 5×10^{-9} different from that given by the radar data. Astronomers can give no reason for this discrepancy; it is currently considered an unsolved mystery. However, the discrepancy is similar to the amount we would expect from our macrocosmic vacuum polarization wave if the magnitude of the effect is of the order of 10^{-7} at Mercury.

The Earth itself has limited amounts of plasma, and rotates slowly. So it would be expected to be a relatively weak source of such vacuum polarization waves. Moreover, we live primarily at the surface of the planet, at a node, where they would be at their weakest. It is noteworthy, therefore, that most of the anomalous gravitational measurements which recently led to the hypothesis of a "fifth force" took place away from the surface: deep in mines or high in towers (Stacey, 1981; Holding, 1984; Eckhardt, 1988; Zumberge, 1988).

These anomalies were all "explained away" as being "possible" density variations in the Earth. Since such an explanation was barely possible, though certainly not proven, it was instantly accepted as a paradigm-saving explanation, and the anomalies wished away. However, the number and scientific rigor of these experiments must surely create doubt that *all* of them "just happened" to be performed in regions of massive and hitherto unobserved density variations. Moreover, the Holding experiment was performed in an Australian mine complex, where surrounding densities are well known; the Zumberge experiment was performed deep in the Greenland ice sheet, whose densities are also well known; and the Eckhardt experiment high in a tower, where earth density variations should have minimal effect. It would seem that vacuum polarization might provide the first remotely plausible explanation ever given for these anomalous measurements.

So we see that there are a number of unexplained anomalies, at least one associated with the Sun and each of the inner planets. The magnitude of these anomalies is very large at the Sun itself, where it amounts to "the greatest problem in solar physics," large at Mercury, and diminishing in intensity at Venus, Earth, and Mars. And, of course, the powerhouse Jupiter system contains several immense anomalies.

There is even a tiny anomaly measured with respect to the Pioneer 10, 11, and Ulysses spacecraft which have completely exited the solar system. They seem to be experiencing an unexplained "sunward pull" of about 1/10 billionth of g.

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Richard Feynman, one of the last real physicists, famously remarked that, "If all of mathematics disappeared, physics would be set back exactly one week."

Since the anomalies diminish in magnitude with distance from the Sun, the source of all of these anomalies is clearly the Sun itself. All of these anomalies can be explained, qualitatively at least, by our hypothesis of a macrocosmic polarization wave originating in the Sun's spinning plasma.

Cosmological Consequences

Let's step back and take a look at the universe revealed to us by our modern instrumentation. We shall try to look as a physicist such as Newton or Faraday might have looked, having regard to such eternal verities as *conservation* and *causality.* The mathematicians who have taken over the discipline manage to ignore these verities, or wish them away with the wave of a magic tensor. Richard Feynman, one of the last real physicists, famously remarked that, "If all of mathematics disappeared, physics would be set back exactly one week." (Of course, M. Kac replied "Yes—precisely the week in which God created the world.")

Newton pointed out the absurdity of unmediated action-at-a-distance. His laws of motion state that if something physical changes its state of motion, something physical must have pushed or pulled on it to cause such a change. Faraday regarded his "lines of force" as real, physical entities. Maxwell regarded his "field" as a mathematical fiction, a convenient way of representing the (physical) I-don't-know-what that causes the observed push or pull.

Dirac's equation, as shown above, supplies that physical I-don't-know-what for both electromagnetism and gravitation, restoring causality. Faraday's lines of force are shown to be real, physical entities, connecting all charges and directly causing the changes in states of motion referred to as "the electromagnetic field." Our "Magnetogravitation" shows gravity to be a similar, though much weaker *physical connection.* Similarly, "the photon" is shown to be a *real wave* carrying *real angular momentum* in a *real, physical medium.*

Among the characteristics of real waves in real physical media is *friction.* However efficient the transmission, some energy must be lost in the process. This is a characteristic of all real waves, and is a requirement of the Second Law of Thermodynamics. One way of expressing the Second Law is that any *transformation* of energy must entail a *loss* of energy. A photon from a distant star starts out very small, with atomic dimensions, but because of the uncertainty principle by the time it reaches here it can have a diameter larger than a continent. These immense photons have been measured by stellar interferometry, where they can be made to interfere with themselves over these large distances (Herbert, 1985). Such a transformation must, by the Second Law, entail at least some loss of energy.

So natural is this expectation that, in 1921, the German physicist Walther von Nernst *predicted* that light from distant sources would be found to have *lost energy* in transmission (von Nernst, 1921). Then, later in the decade, Edwin Hubble (1929) published a finding showing exactly that. The characteristic spectrographic emission lines of light from distant galaxies, he showed, are shifted into the red end of the spectrum, indicating a loss of energy apparently proportional to the distance the signal has traveled, thus exactly fulfilling the Second Law and von Nernst's prediction. Further measurements only confirmed the relationship between distance and this redshift loss of energy, and seven months after Hubble published his findings, the Cal Tech physicist Zwicky (1929) renewed the interpretation that red shift is a frictional loss of energy.

Nothing could be more normal and natural, and consistent with the laws and eternal verities of physics, than that light, like every other real signal, should lose energy in transmission over long distances. That the measured loss of energy is proportional to the distance traveled is direct evidence that light is a real signal in a real medium that obeys the Second Law. This interpretation is further supported by von Nernst's valid, *a priori* scientific prediction, which was *fulfilled* by Hubble's findings. But will you find this logical chain of events, including this fulfilled scientific prediction, mentioned in any mainstream treatment of the red shift? Not a chance. This is because this natural frictional loss of energy was somehow interpreted as a *Doppler shift,* supposedly indicating that everything in the universe is rushing madly away from us in every direction at velocities approaching light speed. How this came about, and came to be enforced as the *official and only permitted* interpretation, must surely be one of the strangest aberrations in all the history of science.

Suppose, when you were a child, your mother called out the window to you, and you couldn't hear her clearly. Did you assume 1) that she was far away, and the signal had attenuated with distance, or 2) that she was moving away from you at a large fraction of the speed of sound, and accelerating as she goes? Surely, in the case of light, the natural presumption must be that the signal has attenuated with distance.

How, then, were we saddled with this bizarre Doppler interpretation? Well, Einstein in SR had rejected the aether on Machian grounds. He called it "superfluous," because there was no measured evidence of an aether, such as a frictional loss of light's energy. Therefore, when exactly such a frictional loss of energy was later predicted by Von Nernst and measured by Hubble, to save the paradigm (and prevent a lot of red faces) it *had* to be explained away as something else. Thus was born, out of desperation, the Doppler explanation—an explanation that Hubble himself rejected, calling it "a forced interpretation of the observational results" (Hubble, 1936). It is therefore a gratuitous insult to his memory to call the supposed rate of expansion of the universe the "Hubble Constant."

Unfortunately, at this time Einstein's GR was looked on as the "shape" of the universe—and it was unstable, rushing toward collapse without the "cosmological constant" that he added as a fudge factor. But if the universe was expanding at a sufficient rate, the stability problem was solved, as Friedmann showed. So the Doppler interpretation of the measured red shift was seized upon to solve both problems—to evade the specter of the aether, and to prevent the collapse of GR.

But there are major problems with the Doppler interpretation, as Hubble knew. The observed red shift is of course *symmetrical,* increasing with distance in every direction with us at the center, exactly as a frictional loss of energy would

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require. But this is a disaster for the Doppler interpretation. It is pre-Copernican, as it would put us once more at the center of the universe. To evade this objection, the Bangers add an epicycle. Though there is no evidence for such a bizarre assumption, we are told that this is not an expansion *into* empty space, but an expansion *of* empty space itself, so that the expansion is uniform everywhere.

But this doesn't work either. If space itself is uniformly expanding, then the space between proton and electron should expand; the space between the Earth and the Sun should expand, the space between the Sun and Pluto should expand. Such an expansion at the Hubble rate would easily be measurable, and simply does not happen (Van Flandern, 1993). So yet another epicycle must be added: the Tensor Fairy is invoked, to wave a magic equation and decree that space expands only where we can't directly measure it, but magically avoids expanding anywhere we *can* measure it.

Further, with millions of galaxies accelerating to inferred velocities approaching light speed, there is no known source of energy that could possibly fuel such expansion. Therefore, the Doppler interpretation flagrantly violates conservation.

Just on the basis of the argument thus far, the frictional loss of energy explanation would be vastly preferred to the Doppler one on the basis of physical law and of Ockham's razor. The Doppler interpretation violates conservation, it violates the Second Law, and it requires two epicycles so unlikely that they tower into fantasy.

There is worse. "Expanding empty space" is another oxymoron, like "curved empty space." Let empty space expand as much as it jolly well pleases, the expansion still can't move so much as an electron. As Newton pointed out, to move anything physical takes something physical pushing or pulling on it. How then did such an unphysical concept as "expanding empty space," with its gross violation of causality, come to be accepted dogma?

It would seem that Einstein created this monster in SR when he argued that a "field," *i.e.* empty space powered only by mathematical equations, could move things about. (Mathematical physicists seem to believe that their equations actually have this mystic power.) He compounded this when, in GR, he Invented the concept that empty space could somehow curve and magically waft planets about. Once one admits into science this gross violation of causality and conservation, the door is open for empty space to perform any miracle you please, such as to accelerate whole superclusters of galaxies to 99% of light speed, without the ghost of a force to move them. Or, if you believe the "Inflation" magicians, it can accelerate them to 10^{48} times *faster* than light.

Moreover, the expanding universe and the static universe which results from a frictional loss of energy make different predictions for a number of matters we can now measure with modern instruments. Van Flandern (2000) lists seven such tests, the results of which overwhelmingly favor the static universe. He concludes: "If the field of astronomy were not presently over-invested in the expanding universe concept, it is clear that modern observations would now compel us to adopt a static universe model as the basis of any sound cosmological theory."

There have, of course, been objections raised to the frictional loss of energy concept. The first has always been, "But space is a vacuum—where would the energy go?" Dirac's equation, of course, provides the answer to that. The second is the problem of scattering—that anything which absorbs and re-emits light would scatter it. Our epho model answers this. The third has been that light-energy is *quantized:* that light presumably could lose energy only in discrete quanta. However, a long series of observations by Tifft (1977, 1990, 1991), Arp and Sulentic (1985), Arp (1987, 1998), and Guthrie and Napier (1988) have all shown that redshifts from stars, galaxies, and clusters *are quantized.* The redshifts step up in small, discrete, consistent amounts, indicating that photon energies step down in small, regular quanta. Though the details are not clear at this time, we will show that this can only be a BEC characteristic, indicating that light loses energy to the BEC only in discrete quanta.

> We see that two incredibly bad choices were made, both at about the same time, both for the same bad reason: to save the paradigm, to evade the increasing evidence for the anathematized *aether,* to keep some "experts" from being wrong and looking foolish. The first bad choice resulted in the truncation of Dirac's equation, and ultimately in the enormity that is the Standard Model. The second bad choice resulted in the enormity that is the Big Bang.

In our laboratories, a superfluid such as ^{4}He confined to a circular ring exhibits the same behavior, which is characteristic of the BEC, in which every part must have the same wave function. If angular momentum is applied to the ring of superfluid, it will not move at all, storing the energy somehow, until every boson component has a whole quantum of angular momentum. Then instantly the entire ring will be in uniform motion.

The same behavior has recently been observed with cold neutrons falling in response to a gravitational field (Van Flandern, 2002). The neutrons don't accelerate smoothly, but in velocity steps of 1.7 cm/second. For instance, a neutron falling at 10 cm/sec in a gravitational field has that constant velocity for an increment of time, then instantaneously is moving at 11.7 cm/sec, then an increment of time later it is moving at 13.4 cm/sec, and so forth. This has been called "Possible Detection of a Gravitational Quantum," but if gravitation itself were quantized as crudely as that, the effect would have been detected long ago.

However, we have shown that neutrons are 90% negative energy, and so are in a semi-condensed state. And like the superfluid above, the neutron as a whole cannot accelerate until every one of its 918 "real" boson components has acquired a quantum of momentum. Therefore, like the superfluid, the neutron accelerates in quantum steps, just as the photon, which is also a BEC phenomenon, loses energy in quantum steps.

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Quasars exhibit the same behavior. They behave like superfluids, and their redshifts repeatedly have been measured to step down in regular quantum steps (Arp, 1998). But because neither of these repeated, confirmed observations of redshift quantization can possibly be explained as a Doppler phenomenon, both have been ignored, denied, and suppressed by Big Bang theorists. Again, the Bang is the theory on which they base their facts.

No other remotely plausible explanation has been given for any of these three classes of observed phenomena. Together, they amount to additional proof both that the nucleon is in a semi-condensed state, and that we are immersed in a universal Bose-Einstein Condensate.

We have seen that without extreme prejudice on the part of scientists in the early 1930s the Bang would never so much as have been suggested. Therefore we will not attempt a detailed critique of the hodge-podge of mutually incompatible theories collectively known as the Big Bang, as that has been done elsewhere (Arp, 1987, 1998; Lerner, 1991, 1992; Van Flandem, 1993, 1996, 1998, 2000; LaViolette, 1995, 1996). All versions of the Bang massively violate conservation and causality, all outrage common sense and the eternal verities of physics, all have failed every observational test. They currently survive only by means of ever-proliferating patches and fudges, epicycles tacked on to save the incredibly cumbersome failed concept. As the astronomer R.B. Tully famously observed, "It's disturbing to see that there is a new theory every time there's a new observation." (Lerner, 1991)

So we see that two incredibly bad choices were made, both at about the same time, both for the same bad reason: to save the paradigm, to evade the increasing evidence for the anathematized *aether,* to keep some "experts" from being wrong and looking foolish. The first bad choice resulted in the truncation of Dirac's equation, and ultimately in the enormity that is the Standard Model. The second bad choice resulted in the enormity that is the Big Bang.

Earlier, Dirac's Equation had shown that the "microwave background" is much more likely to be exhaust from the negative-energy BEC than a residuum from a Bang at infinite temperatures. Moreover, this energy is *uniform,* isotropic to better than one part in 100,000, as would be required of exhaust from the BEC. However, such a hot, uniform gas as the fireball that, on the Bang supposition, would have caused it could never condense into anything, much less the vast structures of superclusters and gaps that we observe. And even if this uniform fireball of hot gas could somehow condense, it could not form these huge observed structures. At the maximum observed intergalactic velocities, these huge structures would take at least 100 billion years to form, seven times the maximum time from the initial Bang (Lerner, 1991). So the microwave background actually disproves any Bang.

With the above argument, showing that light is a real wave in a real medium which loses energy in discrete quanta to that medium, we have removed the last vestige of experimental evidence for the unlikely supposition that the universe arose "from nothing" in a magical explosion. Instead, creation is seen to be a continuing, natural process, without a necessary beginning or end, depending merely on the properties of a single quantized field. Thus it obeys the "perfect cosmological principle" that the Bang disobeys, namely that we occupy no special place, either in space or in time.

There is one further consequence of magnetogravitation as outlined above. If gravitation is to be recognized as a "real" electromagnetic force, rather than some magical, unmediated action-at-a-distance, by the Second Law of Thermodynamics the electromagnetic medium that "carries" the force must "charge" a tiny amount for that conveyance. Thus the epo chains would gradually lose their induced attraction, hence their coherence. When the epos in a chain fell below the critical "temperature" of 2.7'K, they would drop back into the big BEC, and cease to attract at $1/r^2$. Thus gravitation, like any other real force, would have a limited range, rather than magically extending to infinity.

If our magnetogravitation is a correct model, this range should be calculable. We predict that this range will be found to be approximately 2 kiloparsecs. As Van Flandern (1993) shows, if the range of gravitation were about this distance, it would explain the "flat" velocity curves of stars in the spiral arms of galaxies without the need for any (unobserved) "missing dark matter." This "missing dark matter" must, to explain the observed velocities, amount in some regions to thousands of times the amount of matter present in stars. This limited range would also, as Van Flandern observes, explain a large number of other unexplained phenomena, such as the sizes of galaxies.

Conventional cosmology has never been able to explain why matter clumps together into galaxies of a certain characteristic range of sizes, rather than either dispersing completely or massing into a single superclump. Using gravitation of unlimited range, Einstein's GR equations are unstable, requiring a "cosmological constant" *(i.e.* fudge) to explain observations. But a limited range to gravitation would explain a stable, static universe, and many other astronomical mysteries.

Ockham's Razor—A Summary

Merely the assumption that *all* of the solutions of Dirac's equation are both real and meaningful has brought us a long way toward Dirac's unitary dream. We have seen that there are several different reasons for supposing that everything is made of just the four entities that are really two that could be considered only one. The first, of course, is that these are the only solutions to this very general equation that describes "everything that waves." Since two of these solutions are "above 0," the other two must be "below 0." This leads to the necessity of a universal BEC completely filling negative-energy space. The refrigeration requirements of such a BEC automatically require an adjacent positive-energy space for it to dump its waste products. And if our positive energy balance comes from the BEC, as seems necessary, then everything must ultimately be built of epos, as that is all the BEC has to offer. The "electromagnetic field" and the T wave are seen to be epo structures the BEC *must* form to maintain its integrity. And the "photon" is very successfully modeled, not as a "particle," but as positive energy carried by successive waves of epos to conserve angular momentum. The measured frictional loss of energy over large distances is evidence that light is a real wave in a real medium.

This model explains things about the electron never before understood, particularly its immense angular momentum and its "complex" structure, its spin being partly "real" and partly a vibration in an "imaginary" direction. And this complex vibration gives us the "gyroscopic" model of inertia, in which inertia is seen to be a local phenomenon, not depending on unmediated action-at-a-distance by the

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"fixed stars." And the unbalanced magnetic moment exhibited at the same phase by all matter gives us a natural model of gravitation as one more necessary function of the BEC.

So merely with the one assumption that the Dirac equation *means what it says,* we are within sight of a truly unitary view, not only of our present reality, but of its origin as well. If a field *must* give rise to unlimited numbers of particles, as QFT insists, then the Dirac spinor field or, alternately, Treiman's "Zeroth Order Field" *must* fill *some* space with epos, forming a BEC which, as we have seen, must energize an adjacent space with its exhaust. So "creation" is seen not as a miraculous one-time occurrence, but as a continuing, necessary process depending merely on the properties of a quantized field.

We can see that QFT is exactly and completely right—however, just *one* field is all that is necessary, therefore all that is used. We see this economy of means all through nature. Only two particles are necessary, therefore only two are used. From these can be made the three entities that are both necessary and sufficient to build 92 atoms, which suffice for maximum complexity. *Four* entities are both necessary and sufficient to code DNA, the most complex known compound.

This same parsimony of means is seen in the positive-energy states of epos. The sea of negative-energy one-dimensional epos, vibrating in imaginary directions, forms a virtually undetectable background, like "off" pixels in a perfect computer screen. And like a three-way light switch, they "turn on" in three stages, each stage vital to our reality. Epos vibrating in one "real" dimension form the electromagnetic field. Vibrating in two "real" dimensions, they carry angular momentum around at the speed of light: the "photon." And vibrating in three "real" dimensions, they form matter.

As shown above, changes both in gravitation and in the electromagnetic field must propagate much faster than light. Bell's theorem and the proofs thereof show that phase-entangled quantum objects also share information much faster than light. As Nick Herbert says, "A universe that displays *local phenomena* built on a *non-local reality* is the only sort of world consistent with known facts and Bell's proof." In requiring our reality to be imbedded in a BEC, the one extended structure shown, in the laboratory, to demonstrate non-locality, Dirac's equation provides exactly that *non-local reality* in which our local universe is imbedded. These demonstrations of non-locality therefore constitute evidence for the BEC.

Not all of this is original, of course, even to Dirac's equation. The French physicist Le Bon suggested in 1907 that the ether consists of "weightless combinations of positive and negative electrons," which, considering the date, is positively clairvoyant. Others (Phipps, 1976, 1986; Simhony, 1994; Rothe, 2000) have suggested models based on electron-positron pairs, but none has approached the simplicity, elegance, and range of problems solved by the complete Dirac equation.

However, at all times we must keep in mind that this is *only a model.* The map is not the territory, the menu is not the meal. We must remain flexible. This model *must* fail to match the terrain in major and unexpected ways, as all of our theories are by definition *invalid.* Our epo model of the nucleon explains the *size* of the nucleon, the *mass* of the nucleon, the very individual and peculiar *shape* of the strong nuclear force, the *strength* of the strong nuclear force, and several other features that no other model has begun to explain. However, it is perhaps at a stage similar to the original Bohr model of the hydrogen atom. It explains many hitherto unexplained features, but it is perhaps oversimplified and wrong in details, and lacking in quantitative analysis.

We can say with some finality, however, that the Big Bang and the Standard Model are to the physics of the future as Phlogiston is to modern chemistry.

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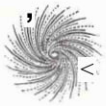

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--- Ken Rauen

Sonofusion

Sonofusion testing has gone essentially no farther since the last update. The testing at 140 volt peak operation through an isolation transformer with the 0.1 inch water gap reactor showed no excess heat under any conditions. We have acquired the custom made 5:1 step up transformer mentioned in the last issue, but we have not given it priority to place it into testing.

Since the last issue was published, NERL tested a proprietary electronic device for nearly a month, from an inventor not associated with NERL; this consumed a significant part of our time. Due to the nondisclosure agreement with the inventor, the details of the testing cannot be divulged yet. However, we were very pleased to observe a clear output excess power of 0.44 watts as measured to an accuracy of ±0.02 watts in our Thermonetics Seebeck calorimeter.

The Lab's funding has become more precarious, so shrewd decisions have placed other projects ahead of sonofusion in an effort to produce good results soon to attract funding. Gene Mallove and I have decided to temporarily halt sonofusion testing. We still believe sonofusion is real; we just do not have the time to identify the parameters of sonofusion fast enough to bring financial stability to NERL.

Catalytic Fusion

Les Case brought a custom-made reactor vessel to NERL for testing. Actually, it was too big to be delivered by truck to his hilltop home during icy weather, so it ended up here. I did some testing with Les' instruction. The details of the reactor and catalyst are proprietary, but I can mention the general activities performed with his system. A larger vessel, roughly 4 feet long and 15 inches in diameter, made of stainless steel in a double-layer, evacuated wall design like a dewar flask, was charged with powdered catalyst, evacuated, back-filled with hydrogen, and heated to about 200°C. This is no doubt the largest "cold fusion" cell ever built!

By monitoring the power into the electric heater, several equilibrium temperature points were collected in the desired temperature range. The vessel was evacuated and back-filled with deuterium, and the same temperature range was monitored for power consumption required. A plot of the results showed no significant difference in power versus temperature between the two gases, indicating catalytic fusion was not significantly occurring. Les has some ideas about why this run did not produce excess heat while the catalyst *was* active in his small-scale testing. He considers this "know how" to be unsuitable for publication yet. This is not scientific research only; it is also research for scaling up to commercial application. The large vessel is intended for self-sustainment. Actually, we did not even anticipate the need to perform the calorimetric study that we did. It is a well-known relationship that the ratio of volume to surface area of a solid geometric shape increases as its dimensions increase. What this means is that, for a given set of reaction kinetics, at some set of dimensions, the internal reaction can provide enough heat to keep itself hot, and thus produce self-sustainment. The caveat concerning a given set of kinetics is the tricky part. Chemical engineers are very familiar with the difficulties of scaling up a bench-top reaction to a commercial production facility, and we are in the same mode of engineering right now. We are awaiting further instruction from Les, following his return to small-scale testing, before any more testing (if any) will be done.

Proprietary projects are now the central focus of my efforts. These will be shared with the readership at the appropriate time. ♦♦♦

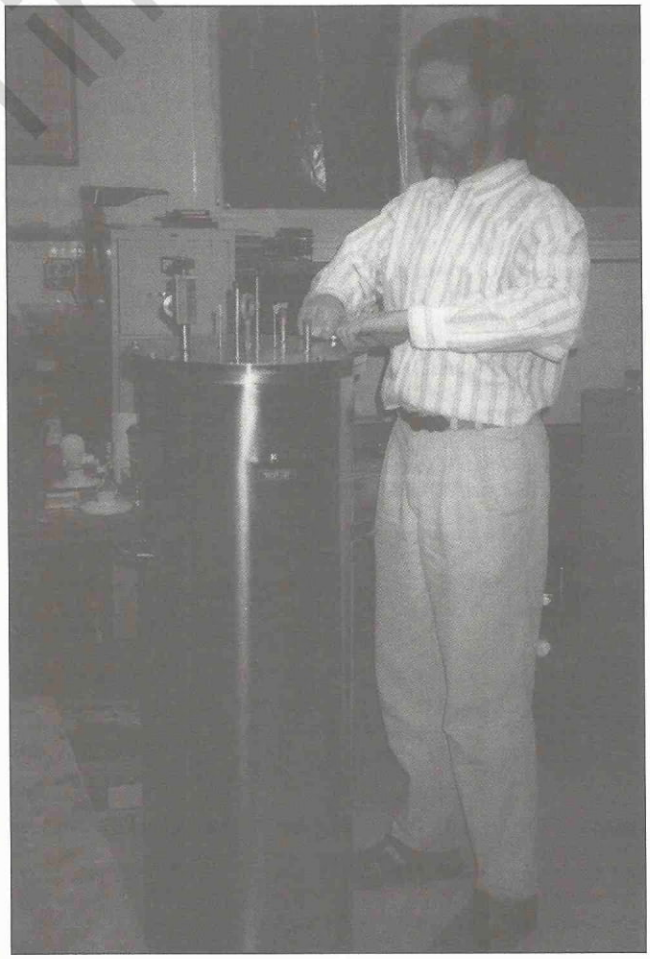

Photo: Eugene Mallove.

Ken Rauen with proprietary catalytic fusion cell loaned to NERL by Les Case.

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Arc-liberated Chcmi-caF Energy Exceeds Electrical Input Energy

Peter Graneau,* Neal Graneau,** George Hathaway,*** and Richard L. Hull****

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Foreword by Peter Graneau

Readers of *Infinite Energy* might like to know that in some of our experiments we substituted heavy water for light water. The result was a slight increase in fog kinetic energy, of about 10%, which we attributed to the greater molecular weight of D_2O. In 1993 we suggested ("Ampere Force Calculations for Filament Fusion Experiments," *Physics Letters A,* Vol. 174, p. 421) that the Pons and Fleischmann excess heat might be due to ionized water filament explosions in fissures of the palladium metal. As this was before the discovery of cold fog explosions, we tried to explain the phenomenon entirely with electrodynamic Ampere forces. Today we would argue that tension caused by electrodynamic Ampere forces creates fog (plasma filament beads) in the capillary sized cavities of the electrode metal, but it is the release of the chemical energy stored in the hydrogen (deuteron) bonds which drives the microscopic explosions.

Historians of science might make a note that this paper was first submitted to *Physics of Plasmas,* a journal of the American Institute of Physics. An anonymous peer reviewer recommended the paper for publication. At this stage the editor stepped in and decided the paper must not be published. This editor was Dr. Donald C. Davidson, the director of the Plasma Physics Laboratory of Princeton University, who administers large funds from the U.S. Department of Energy for the development of hot fusion.

Abstract

This paper reports the first experimental results in which the kinetic energy of cold fog, generated in a water arc plasma, exceeds the electrical energy supplied to form and maintain the arc. The cold fog explosion is produced by breaking down a small quantity of liquid water and passing a kiloampere current pulse through the plasma. The ninety-year history of unusually strong water arc explosions is reviewed. Experimental observations leave little doubt that internal water energy is being liberated by the sudden electrodynamic conversion of about one-third of the water to dense fog. High-speed photography reveals that the fog expels itself from the water at supersonic velocities. The loss of intermolecular bond energy in the conversion from liquid to fog must be the source of the explosion energy.

1. Research Motivation

Before describing the latest experiments concerned with cold fog explosions, the motivation for this research will be explained. In 1994, we discovered that when a small quantity of water (usually but not necessarily distilled) is converted to high-density fog within microseconds, the fog explodes violently. Fog is defined as a multiplicity of tiny water droplets that float in air. The discovery has been fully described in a book dealing with pre-Maxwellian electrodynamics (Graneau and Graneau 1996). More recent findings have been discussed in a previous paper in this journal (Hathaway *et al.* 1998).

The fog generator is a small water-filled electric arc cavity to be described later. In a typical explosion, the cavity receives less than about 50 J of electrostatic energy from a high-voltage capacitor. Almost all of the input energy is converted to low-grade heat, raising the water to a few degrees above ambient temperature. This heat is incapable of raising steam or contributing in any other way to the explosion. It seems inevitable that the fog is being produced by electrodynamic forces in the current-carrying arc plasma. Such forces can furnish the mechanical surface-tension energy required for tearing bulk water apart into tiny fog droplets.

With 50 J of input energy, the quantity of fog produced is of the order of 0.75 g of water. To dissociate this amount of water into oxygen and hydrogen would require 10 kJ of energy. Hence the fog explosion is unlikely to be caused by electrolytic dissociation of water molecules. Without this dissociation, the most likely source of the explosion energy is that stored by hydrogen bonds between the water molecules. This bond energy is said to be equal to the latent heat of evaporation, and therefore could contribute up to 2200 J g^{-1}.

Figure 1 depicts the proposed renewable water energy cycle. The fog contains less H_2O-H_2O bond energy per gram than a raindrop. In other words, its latent heat of evaporation is less than that of bulk water. This is known from the fact that the equilibrium vapor pressure just outside a water droplet increases with decreasing droplet diameter (Young 1993). The internal-energy difference between the cold fog expelled from the accelerator must be made up by atmospheric heat—that is, essentially by solar energy. No other energy source appears to be available for replacing the extracted kinetic energy.

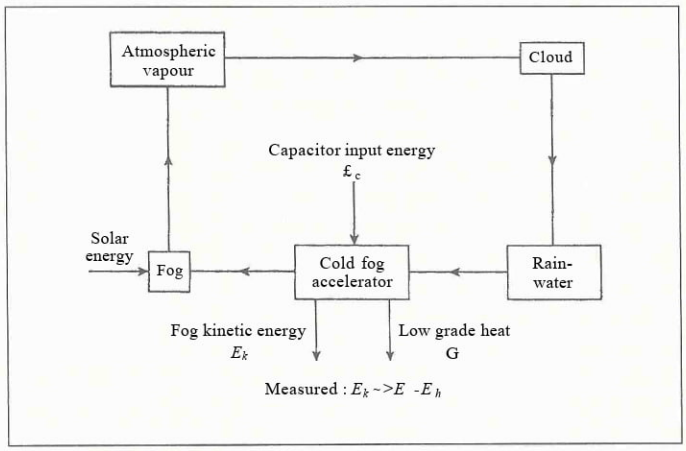

Figure 1. Renewable water energy cycle.

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2. History of Water Arc Explosions

It appears that the encounter of water drops with an electric arc produced the first photograph of a cold fog explosion. This is shown in Figure 2, which was published by Trowbridge (1907). He must have realized that steam and water vapor were invisible in air, which left him with no explanation of the white explosion cloud. In his early high-voltage laboratory at Harvard University, Trowbridge discovered another effect that has a bearing on fog explosions. He stretched a sheet of paper along the path of his sparks of more than 50 cm length, and found that at every comer and forking of the lightning-like discharge, holes were punched through the paper without any burning or charring. It took eighty years until experiments of this kind were repeated at MIT and revealed that thunder was not the result of heat and the thermal expansion of the lightning channel (Graneau 1989), as had been assumed during most of the twentieth century. It was shown instead that the shock wave in air was driven by non-thermal forces, of which electrodynamic forces were then considered to be the most likely. In view of the findings reported in the present paper, it is possible that cold fog explosions also contribute to the mechanism that causes thunder.

During the Second World War, Frungel (1948) measured the unusual strength of water arc explosions. He concluded that the explosions were not caused by heat and steam, and admitted freely that he was unable to explain the phenomenon.

Soon after Frungel's publications, water arc explosions found applications in electrohydraulic metal forming (Gilchrist and Crossland 1967) and underwater pulse echo sounding (Frungel 1965). Not until the mid-1980s was the scientific basis of the puzzling explosions more extensively researched at MIT (Azevedo *et al.* 1986). It was then shown that the discharge of 3.6 kJ of stored capacitor energy would create pressures in excess of 20,000 atm, in 7 ml of saltwater: 3.6 gm of water was ejected from the accelerator barrel with a velocity of the order of 1,000 m s^{-1}, and then punched a 1/2-inch-diameter hole through a 1/4-inch thick aluminum plate (Graneau and Graneau 1996).

At the time, it was conjectured that the water was flying through the air as a coherent liquid slug, since that would create the greatest impact. No evidence of boiling and steam formation could be detected, and all the water found after the explosion was cool. Accepting the general view that plasmas are quasineutral and do not explode as a result of Coulomb forces, the available evidence seemed to leave little doubt that the explosions were driven by electrodynamic forces. This discovery motivated a ten-year investigation of the electrodynamics of water arcs. The Lorentz force could not account for more than a small fraction of the observed force. Ampere's force law (Graneau and Graneau 1996) fared better, but still fell short of predicting the measured values by at least a factor of 10. The search for a new electrodynamic force was finally abandoned in 1994.

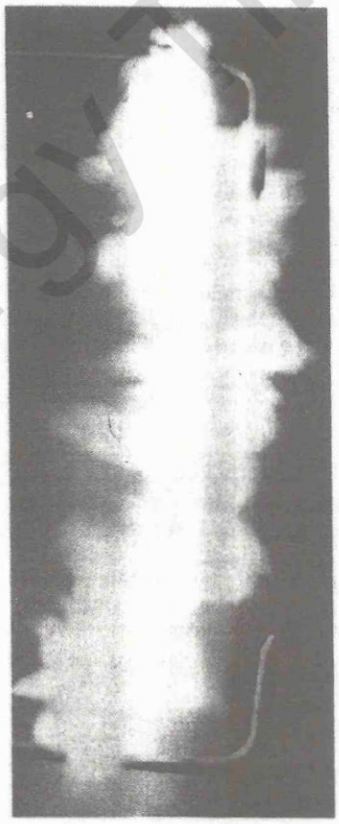

Figure 2. Trowbridge's (1907) photograph of a cold fog explosion. The arc is ~40 cm long.

Another report of electrically induced explosions in water came from Kansas State University. Johnson (1992) claimed that the loudness was distinctly greater than that obtained with an equivalent amount of gunpowder. He found that the remaining water droplets were cool to the touch and that apparently no steam had been produced. Johnson suggested that the explosions may have been due to longitudinal Ampere forces, and were tapping a new source of energy.

In 1994, the present authors took the first high-speed photographs of water ejected from an arc accelerator, and discovered that the leading high-speed component was not a coherent liquid, but actually very dense fog, which finally expanded in the air under the laboratory ceiling. By trapping the fog in a balsa-wood absorber and measuring its temperature, it was found that the fog was still cold—at most a few degrees above ambient temperature. The discovery of cold fog explosions changed our scientific outlook on the remarkable behavior of water arcs.

3. Accelerator and Discharge Circuit

Our experimental technique and many previous results were published in Graneau and Graneau (1996) and Hathaway *et al.* (1998). Here we cite later results together with brief details of the relevant accelerator and discharge circuit as well as the diagnostics involved.

Figure 3 shows a cross-section through the Type A accelerator which has been used extensively since 1984. During this period, it has been made of different materials and has employed a variety of water charge volumes w and breech-to-muzzle lengths 1. For example, fog penetration of a 1/4-inch-thick aluminum plate was achieved with an accelerator using a steel barrel of $I = 10$ cm and $w = 7$ ml of saltwater. Subsequent shots have not used saltwater. In the latest experiments reported in this paper, the shaded metal components were made of copper and the remainder was a nylon sleeve and a nylon block. The essential dimensions are indicated in Figure 3, with, typically $/ = 3.0$ cm and w = 3.5 ml of distilled water. The water level was 0.26 cm below the muzzle.

The secondary projectile stood on top of the muzzle, and consisted of a 2.65 cm diameter balsa-wood cylinder of 3.2 cm length pressed into a copper can to add strength and weight, making the dry secondary projectile mass approximately $M = 65$ g. Behind the accelerator stood a scale on which a video camera recorded the height h to which the wet mass $M + m$ ascended, where m is absorbed fog mass.

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In a typical experiment, the energy storage capacitor C = 0.565 pF was connected between the barrel electrode and the baseplate-and-rod electrode. The switch S was a triggered spark gap in atmospheric air, which trapped a certain amount of residual charge in the capacitor when the switching arc interrupted the oscillating discharge at low current.

In Figure 3, the distributed circuit resistance and inductance are indicated by lumped parameters R_c and L. The discharge current i was measured with a current transformer T and a digital storage oscilloscope DSO. The electrostatic voltmeter ESV recorded the charging voltage V_o on the capacitor terminals with the switch S open, and the residual voltage V_r after the switch had been fired and then interrupted the current flow. With S open, the high-voltage power supply HV was connected across the capacitor for each shot. After reaching the desired voltage V_o, the supply was disconnected. Closing the switch S initiated the fog explosion, with the underdamped discharge current ringing down over a few microseconds.

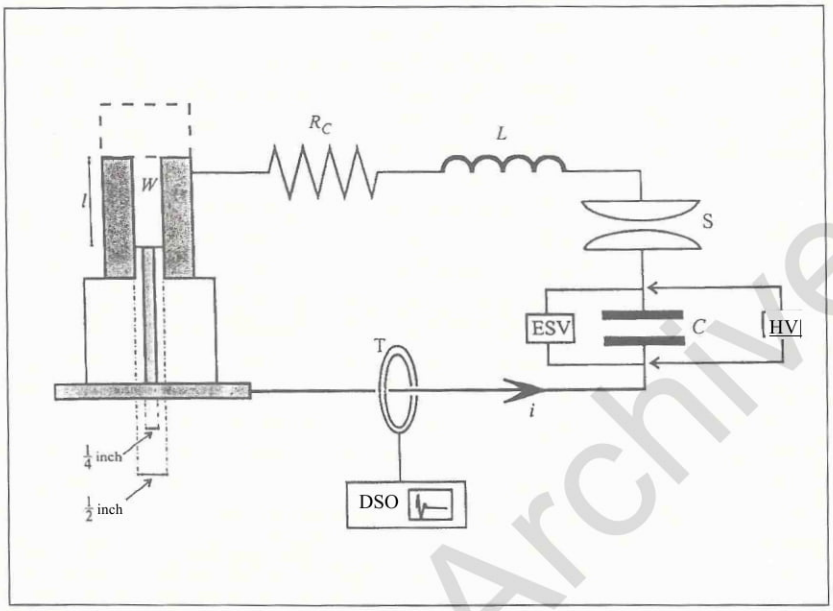

Figure 3. Type A accelerator with discharge circuit.

4. Evidence of Fog

That water arc explosions are in fact cold fog explosions was discovered with high-speed photography at Oxford University (Graneau and Graneau 1996; Hathaway *et al.* 1998). In the present paper, we are presenting further photographic evidence of fog generation that reveals interesting properties of the fog jets.

Figure 4 is a series of numbered photo frames showing the emergence of fog from the muzzle of a water arc accelerator as the fog pierces the atmosphere. The high-speed film was shot in the HCS Laboratory in Toronto at 35,000 frames per second. A powerful light flash, triggered by the switch S of Figure 3, was directed at the experimental apparatus. The camera formed images of the travelling fog on a rotating mirror, which reflected them to a film adhering to the inside of a rotating drum. The time interval between successive frames was 28.6 [is.

Water vapor is invisible in air. Relatively large water drops and films of water are transparent. They show up on photographs only because of thin lines of light that are reflections from the water surfaces. The uniform whitish-grey appearance of fog and clouds is due to light scattering by a multitude of small droplets. Hence the photographs in Figure 4 conclusively prove the emergence of fog from the accelerator barrel. Video camera records obtained in the laboratory of Tesla Coil Builders of Richmond (TCBOR) revealed that the fog slowed down quite rapidly as it penetrated the atmosphere. On reaching the ceiling, it rolled around like a cloud for a number of seconds while it evaporated.

When the accelerator depicted in Figure 3

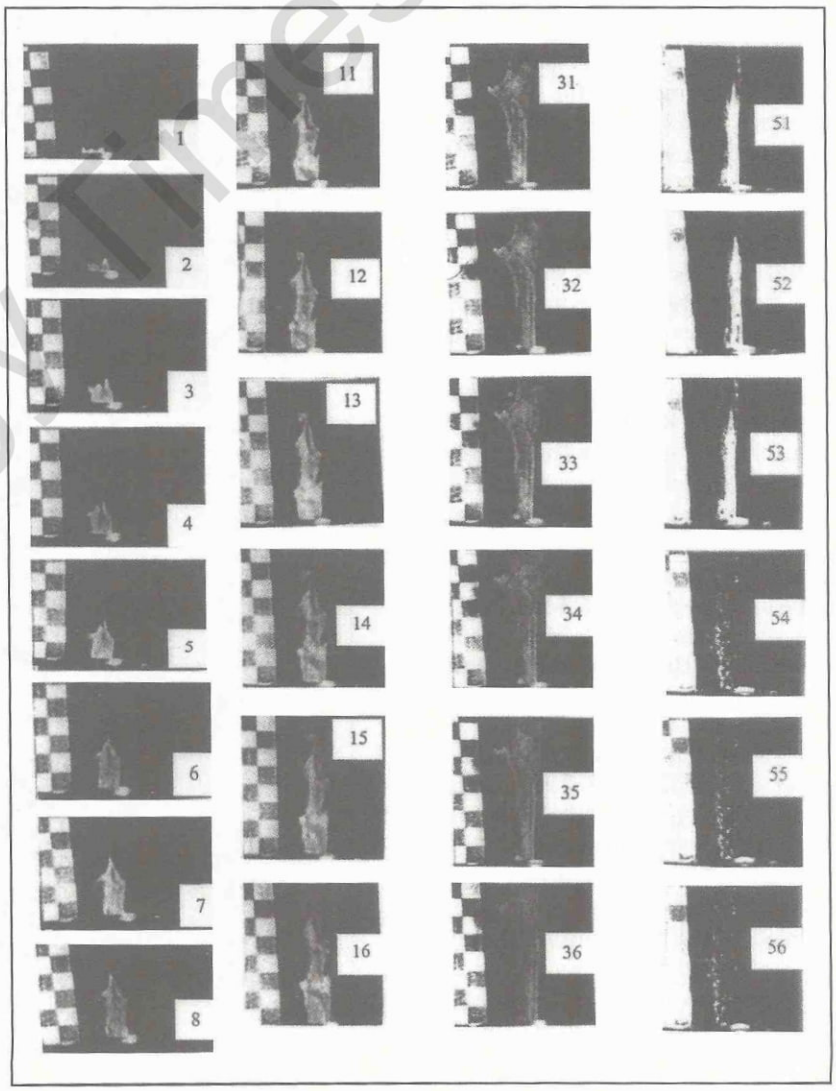

Figure 4. High-speed photography of a fog jet, 35,000 frames per second.

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stood on an aluminum sheet spread out on the floor, it was observed that small droplets of mist rained out of the cloud. Fog droplets that float in air are said to be of diameters ranging from 1 to 100 pm. The fog recorded in Figure 4 is likely to have contained some larger droplets that fell in air, but, for the purpose of this paper, we shall call the mixture of very small floating and falling droplets "high-density fog." In other photographs (Graneau and Graneau 1996), larger drops of water were seen to follow behind the fog, some of which were millimeters in diameter and travelled at much lower velocities.

Figure 4 shows a selection of the nearly 200 frames recorded by the camera during a single shot. The fog column diameter just above the muzzle is equal to the accelerator barrel diameter, which was 1.27 cm. This immediately proves that the fog is cold and, unlike steam, does not expand laterally. A centimeter scale stands to the left of the fog column, and, by knowing the camera speed, the average velocity of the head of the fog column, taken over the first eight frames, was measured to be approximately 200 m s'^{1}. The fog appears to be coasting in the inertial mode. It is not understood why, initially, the column has a pointed tip, which would normally indicate supersonic speed (> 350 m. s^{-1}). Anyhow, frames 11-16 show air ablation of the tip. By frames 31-36, a mushroom-shaped head has emerged with pronounced lateral fog spreading due to atmospheric ablation. Mushroom heads usually result from subsonic progression, and frames 31-36 demonstrate a velocity of 65 m s^{-1}.

The high-speed camera was triggered by the switch that initiated the arc discharge. This occurred no more than 28.6 its before the exposure of frame 1. As the fog emerged from the muzzle, the explosion must have been over—otherwise it would have resulted in lateral fog expansion. This finding suggested that the explosion period was limited to the time during which the arc current was flowing, which was of the order of 10 ps. Heat could not have been the cause of the explosion, because this would have persisted for more than 28 ps.

The arc forms near the breech of the accelerator, located at the bottom of the water column. This is where the fog is likely to be generated. The water column in the barrel was 3 cm long. No water appears to have been pushed ahead of the fog, which initially may have travelled with a velocity as high as 1000 m s^{-1}. Other photographs have indicated that the fog breaks through the water surface without causing as much as a ripple. The implication is that the leading fog droplets are extremely small and spaced apart from each other. The smaller the droplets, the more bond energy per unit mass has been liberated and the more strongly the droplets should repel each other.

A transition from fog to transparent water begins to show in frames 51-53. Frames 181-185 depict a liquid flow at 15 m s^{-1}. The water in the latter frames must have been a hollow film tube with a few droplets in the surface, since normal-density liquid water could have only accounted for a 3 cm long solid column.

Figure 5 is a single frame taken with an ordinary video camera in the HCS Laboratory. In this case, the liberated chemical energy is much greater than in the high-speed film of Figure 4. In Figure 5, the fog plume is 2 m tall, and its shockwave-shaped pointed tip very clearly travels at supersonic speed. This photograph reveals the light source about 50 cm to the right of the fog jet.

When a balsa-wood cylinder in a metal cup stood on the muzzle of the accelerator, the fog penetrated deep into the porous material and transferred momentum to the projectile, which was thrown vertically to a height *h*. Weighing before and after a shot made it possible to determine the dry mass *M* of the projectile and the absorbed fog mass *m*. Since the two masses travelled together at the initial projectile velocity v_0, momentum conservation required that

Figure 5. Two-meter-tall supersonic fog jet. Approximate fog density 1 kg rrr^{3}.

$$?nu_{av} = (J/+m)v_0, \qquad (1)$$

where u_{av} was the average velocity of the absorbed fog. Then it follows from energy conservation that

$$\tfrac{1}{2}(M + \qquad = (M + m)gh, \qquad (2)$$

or

$$v_0 = v2pA, \qquad (3)$$

where *g* is the acceleration due to gravity.

From (1) and (3), the average fog velocity can be calculated as

$$u_{av} \sim \frac{M + m}{m} V2gh. \qquad W$$

This average velocity gave the minimum kinetic energy of the fog as

$$E_{k,\min} = \tfrac{1}{2} m u_{av}^2. \qquad (5)$$

The true kinetic energy of the fog depends on the root-mean-square (rms) velocity of the droplets, because for *n* droplets of mass Am travelling at velocity *u,* we have

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$$E_k = \sum_n \tfrac{1}{2}\Delta m \text{«}^2 = \quad \underset{n}{\mathrm{E}}\ \mathrm{Am} = \tfrac{1}{2} m u_{\mathrm{rms}}^2. \qquad (6)$$

Sections cut from the balsa-wood revealed that fog penetration varied widely from place to place. However, in general, the velocity distribution has the form of a half-cycle of a sine wave. The average ordinate of the sine wave is the amplitude divided by 1/2 rr and the rms value is the amplitude divided by 2, yielding

$$^{w}\mathrm{rms} = 1\text{-}1\ ^{u}{}_{\mathrm{av}}. \qquad (7)$$

The rms velocity is not very different from the average velocity, and (7) has been used in the evaluation of the fog kinetic energy.

5. Energy Flow Diagram

The energy flow through the discharge circuit and accelerator to the fog jet can be better understood with the aid of Figure 6. The capacitor receives an energy E_1 from the high-voltage charging unit. Recognizing that a small amount of the energy remains in the capacitor, $E_2 < E_1$ is supplied to the discharge circuit, which is shown as separate from the accelerator. In the metallic components of the circuit and in the switching arc plasma, part of E_2 is dissipated as Ohmic heat E_3, which is proportional to i^2 and can be measured. For the purpose of Figure 6, the ionization loss in the switch is added to the ionization loss in the water to give $£_s$, which contributes to the measured damping of the ringing discharge.

In addition to the absorbed ionization energy, which does not heat the water but is stored electrostatically until the ions recombine well after the explosion, some Ohmic heating of the water plasma takes place. This has been measured approximately with a thermocouple, and is labelled E_6.

Disregarding the fact that it is a plasma, the water itself acquires kinetic energy $£_9$, which is evidenced by the explosion. We let E_7 be the non-thermal mechanical energy required for tearing the liquid apart into fog droplets. Any liberated internal water energy E_8 may be added to $£_7$, and contributes to $£_9$. Before the kinetic energy of the fog jet $£_{12}$ is measured, the fog has to penetrate a certain volume of liquid water, and is likely to dissipate some of its energy owing to viscous drag. This loss component is denoted by $£_n$. Whatever forces accelerate the fog in the water will also exert pressure on the cavity walls. The resulting strain and deformation energy stored temporarily in the wall material has been labelled $£_{10}$.

The critical quantity of the energy flow diagram is E_7. Measurements (Graneau and Graneau 1996) of £3, E_s, and $£_6$ have established that $£_7 \ll £_2$. In the relevant experiment, $£_2$ was usually less than 50 J and the water quantity was never less than w = 1 ml. It follows from these figures that the water temperature could not exceed the ambient temperature by more than 12°C. Furthermore, it was established by experiment with a photodiode that the arc current i was negligibly small until the water plasma was fully glowing in the accelerator barrel. Hence no selective subheating of a subvolume (filament) of w would have occurred. These facts determined once more that £7 was not heat energy. It has to be electrodynamic energy associated with magnetic forces.

The numerical energy quantities in Figure 6 apply to shot TA70571 of Table 1. Where estimates have been made, the figure is preceded by the "approximate" symbol =. In all other cases, actual measurements are presented. The methods used for estimating and measuring energy losses are described more fully in Graneau and Graneau (1996). The estimated value of $£_5 + £_6 \sim 25$ J would produce a temperature rise in the 3.5 g of water in the accelerator of about 1.7°C. This is consistent with temperature measurements made in other experiments.

It should be noted that in shot TA70751, the amount of fog absorbed in the balsa-wood secondary projectile was 0.537 g. If at any time this water mass had existed as steam, it would have required the expenditure of 1213 J, an amount equal to the latent heat of vaporization. However, the total energy discharged from the capacitor was only $£_2$ = 40 J. This was clearly insufficient to explain the explosion by the adiabatic expansion of steam.

The most intriguing feature of the energy flow diagram is the large magnitude of $£_{12}$ as documented in the following section. This demands the supply of internal water energy $£_8$.

6. Fog Kinetic-energy Results

Table 1 lists the measured kinetic energy of the fog jets in eight shots fired under identical conditions with the Type A accelerator of Figure 3. As already explained, almost all of the fog kinetic energy is derived from internal water energy, and $E_7 \ll E_2$. The results in Table 1 show that in five of the eight shots, the kinetic energy of the fog was greater than the energy supplied by the storage capacitor. In other words, we achieved $£_{12}/£_2 >$!• The ratio £12/ 2 i$ ^{one}$ °f several markers indicating the release of internal water energy.

To appreciate how small the thermal action of the 40 J input energy is, it helps to think of an ordinary match, which liberates between 100-200 J of thermal energy. If this energy is used to heat 3.5 ml of water in a test tube, it will certainly not

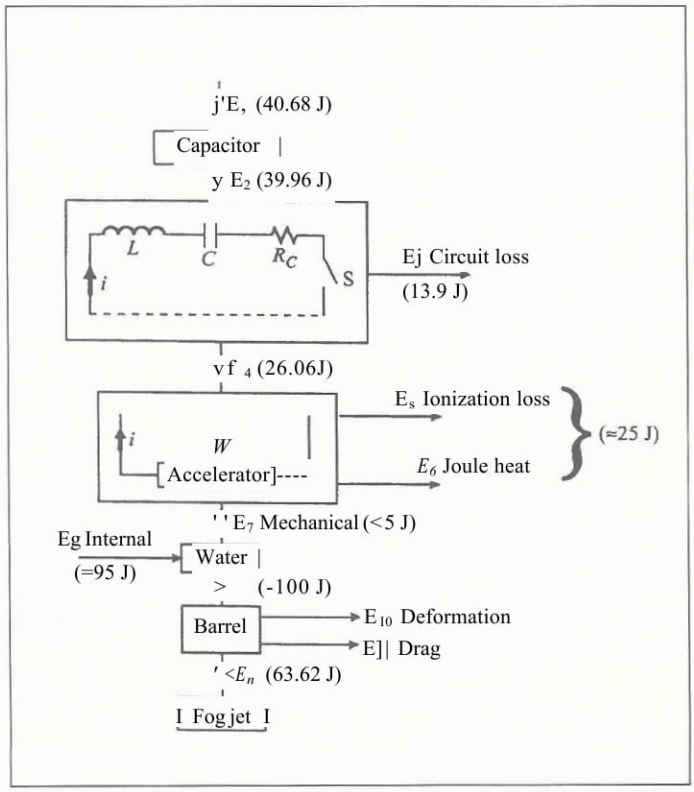

Figure 6. Energy flow diagram for shot TA70571.

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Table 1. Results of eight shots with the Type A accelerator, with F_0 = 12.0 kV, V_r = 1.6 kV, C = 0.565 pF. E_2 = 39.96 J l = 3.0 cm and w = 3.5 ml (distilled water).

Shot	M (g)	m (g)	h (tn)	A\i (■!)	E_{12}/E_2
TA70564	69.278	0.718	0.57	40.54	1.015
TA70565	65.363	0.608	0.58	50.18	1.256
TA70567	64.548	0.632	0.48	39.00	0.876
TA70568	64.200	0.621	0.56	45.80	1.146
TA70569	63.588	0.843	0.59	35.12	0.879
TA70570	65.481	0.659	0.58	46.54	1.165
TA70571	64.905	0.537	0.66	63.62	1.592
TA70572	63.660	0.823	0.54	32.98	0.825

cause a water explosion, nor will it produce a noticeable lift of the water surface. This immediately suggests that E_7, which must be responsible for the fog explosion, has to be mechanical energy. In any case, the measured low-grade heat losses $E_3 + E_5 + E_g$ account for almost all of the input energy E_z (Graneau and Graneau 1996), leaving very little for E_7.

Dielectric breakdown and ionization do not result in an explosion unless subsequently a significant amount of current flows through the arc plasma. This is supported by the fact that breakdown and ionization are energy-absorbing phenomena. The strong current dependence of the explosions was already demonstrated by Azavedo *et al.* (1986). In their work, lowering the maximum pulse current from 25 to 12 kA reduced the explosion impulse from 7.0 N s to 1.5 N s. Currents of less than 1,000 A yielded negligible explosion forces. The ionization of water during the breakdown and plasma generation phase, as well as any Coulomb forces associated with charge separation, do not appear to be responsible for the arc explosions. This leaves only electrodynamic (magnetic) forces between current elements as the possible cause of the explosions. The strength of the explosions undoubtedly increases with the current i, and this is in accordance with electrodynamic processes.

If F is the time-varying force that accelerates the fog droplets then Newtonian mechanics requires that the impulse of this force, $JF\,dt$, has to generate the initial fog momentum mu_w. Let a constant effective force F_e be defined, acting for an interval -r, such that it is equal to the impulse)F dt. Then

$$\int F\,dt = F_e r = m u_{av}. \tag{8}$$

The average velocity can be calculated from (4). The time constant T of the underdamped discharge current will be assumed to be the interval during which F_e is active. In the absence of steam, it is difficult to see how the force pulse could be stretched out beyond the length of the current pulse. The discharge current has the form

$$i = \quad \sin M, \tag{9}$$

where a>is the angular ringing frequency. From current oscillograms, a typical value of the time constant was r = 4 ps. This resulted in F_e = 52,400 N for the weakest shot (TA70572) of Table 1, or an effective pressure over the cross-sectional area of the accelerator barrel of 4.14 x 10^8 N nr^2, which is equal to 4,220 atm. This would appear to be sufficient pressure to achieve the observed fog acceleration.

Maxwell's electromagnetic field theory indicates that by far the strongest electrodynamic force on the plasma arc column is the magnetic pinch exerted by radial Lorentz forces. This produces an axial thrust that could expel water from the barrel. To make this force a maximum, we take the optimistic view that the current flows all in the axial direction. Northrup (1907) showed that the total axial thrust on a cross-section of a cylindrical current distribution is given by

$$F = \frac{\mu_0}{4zr}\frac{i^2}{2}, \tag{10}$$

where p_0 is the magnetic permeability of free space. The impulse of this pinch thrust can again be expressed by an effective force F_e such that

$$\int F dt = F_e T = \quad \int i^2 dt. \tag{ii}$$

The action integral $\int i^2\,dt$ was measured for many discharges, and a typical value was 130 A^2 s. With this information, the effective Lorentz thrust of (11) becomes F_e = 1.6 N, as compared with the force of 52 kN required to accomplish the observed fog acceleration.

Newtonian electrodynamics (Graneau and Graneau 1996), which was widely taught and used in the nineteenth century, gives a larger effective electrodynamic force, possibly as high as 60 N. This is, however, still far too low to explain the fog acceleration. The chance of accounting for the observed fog accelerations with electrodynamic forces is even worse than these figures indicate, since E_9, the true fog accceleration energy, must be greater than E_{12} because of deformation and drag losses, and could even be twice as large as the measured energy.

The considerations outlined in this section demonstrate that, quite apart from the fact that $E_{12}/E2 > C$ the observed fog explosions demand the supply of internal water energy.

7. Water-to-Fog Conversion

Condensation of water vapor in the atmosphere is the greatest fog producer on Earth. It is a relatively slow process, which cannot generate a sufficient amount of fog in a few microseconds to cause an arc explosion. In the early formative stage of a water arc, the fog density must approach that of liquid water, and is therefore up to 300,000 times as great as the fog density of clouds (approximately 3 g nr^3).

It is difficult to think of any other way of creating the dense fog than by mechanically tearing the liquid apart into tiny fragments. These are the fog droplets, ranging in size from 1 to

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100 pm in diameter or smaller. As discussed previously, the tearing force must be an electrodynamic force, but the direction of the Lorentz force is not such that it could split water into droplets. On the other hand, the Ampere force, or Ampere tension as it is often called, is well qualified to describe the break-up of the liquid.

The most well-known consequence of Ampere tension in metallic conductors is the phenomenon of wire fragmentation. In liquids and plasmas, it leads to plasma bead formation, which has been observed in plasma focus fusion, deuterium-fiber fusion, and capillary fusion experiments. These phenomena are fully reviewed in Graneau and Graneau (1996). Hence it is not only possible but likely that Ampere tension will generate fog in water arc explosions.

Surface tension requires that tearing forces be involved in the breakup of the liquid. The surface tension 7 of water at 20°C is 72.75 dyn cm^4. It turns out that surface tension energy per unit area has the same dimension as surface tension per unit edge and is numerically equal to it, so that

$$7 = 72.75\,\text{dyn cm}^4 = 72.75\,\text{erg cm}^{-2} = 72.75 \times \text{KT}^7\,\text{J cm}^4. \quad (12)$$

The fog mass generated in the experiments of Table 1 varied between 0.537 g and 0.843 g. Let us evaluate the additional surface-tension energy required to convert 1 g of water into fog. If the drops are all of the same diameter d then the number density n of droplets generated will be

$$n = \frac{6}{\pi d^3}. \quad (13)$$

Fog droplets are said to be between IO'^{4} and 10'^{2} cm in diameter. Hence the number of droplets lies in the range from 1.9×10^6 to 1.9×10^{12} per gram. The total new surface energy E_s for drops of the same size is

$$E_s = ynird^2. \quad (14)$$

For the two extreme droplet diameters of IO'^{2} and IO'^{4} cm, this energy comes to 4.37 and 437 mJ respectively. Hence the part of E_7 in the energy flow diagram of Figure 6 that must supply surface tension energy is only a fraction of one joule. The Ampere tension forces can comfortably meet this energy demand, and may have some strength left over for fog acceleration. These findings lead us to believe that Ampere tension is responsible for the conversion of liquid water into dense fog.

8. Energy Conservation

If energy is to be conserved then the internal energy per unit mass of fog (see Figure 1) has to be less than that of rain water. During the explosions, the water molecules do not appear to undergo chemical changes; so the energy difference must be explained by a change in the intermolecular bond energy per unit mass. This reserve of energy is believed to be equal to the latent heat of evaporation, and, in the case of rain water, it comes to 2,259 J gm^4.

In shot TA70571 (see Table 1), 0.537 g of water was converted to fog. The latent heat of this amount of water is 1,213 J. The measured fog kinetic energy came to $£_{12}$ = 63.62 J. This is just over 5% of the latent heat. Furthermore, extensive analysis presented in Graneau and Graneau (1996) and Azevedo *et al.* (1986) has demonstrated that electrodynamic forces could only amount for a negligible portion of the kinetic energy developed in arcs. Therefore almost all of the input energy E_2 (E_c in Figure 1) is converted to low-grade heat, so that nearly all of $£_{12}$ must have come from the 1,213 J stored in the bulk water.

This calculation has ignored the $£_{10}$ and $£_u$ losses shown in Figure 6. Hence the energy liberated in the water-to-fog conversion is greater than 5% of the stored energy, implying that the latent heat of the fog created by the accelerator contains less than 95% of the latent heat of bulk water. As demonstrated by (14), less than 1 J (0.1% of the latent heat) of the stored energy loss can be associated with additional surface tension energy acquired by the fog. Therefore the remainder must have resulted from differences in the water structure. How this average structure and the intermolecular bonding changes with the number of molecules in the droplet is a topic of physical chemistry that is a subject of intense research (Postorino *et al.* 1993; Li and Ross 1993; Li 1996). The difference in the latent heat between fog and bulk water is eventually restored by heat in the atmosphere, which allows the fog to condense and return to Earth. Our investigation has not yet extended into the details of water structure, but the discovery of cold fog explosions will help in this direction.

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REVIEW OF "The Einstein Myths: Of Space, Time, and Aether"

Arnold G. Gulko*

In Issue 38 of *Infinite Energy* magazine (2001) Editor-in-Chief Eugene E Mallove discusses Einstein's legacy, in an editorial titled "The Einstein Myths: Of Space, Time, and Aether." While this writer does not agree with some of the points made, Mallove's presentation is excellent. Of great interest are his quotes from Einstein, which reveal this great man's humility about himself and his achievements. On the one hand he notes Einstein's comment: "the contrast between the popular assessment of my powers and achievements and the reality is simply grotesque." He also notes Einstein's further comment to his friend in 1930, "To punish me for my contempt of authority, fate has made me an authority myself." Einstein's life and his attitude toward himself being elevated to sainthood and his works being elevated to incontrovertible fact are adequate testimony to his expectation that those works would be just another step in the search for fundamental truth. If someone thinks Einstein contributed anything more or less than a vigorous effort to understand our nature, he is in error. Mallove even notes that Einstein recognized his theories were not invulnerable by quoting his statement: "A scientific person. . .will never believe that the results of his own attempts are final."

That issue of *Infinite Energy* magazine is devoted to a reconsideration of Einstein and his contributions, and this suggests two matters be set straight immediately. First, Einstein tried to understand the fundamentals of the nature around him, and that objective was at the core of his motivation. This is why he could not accept quantum mechanics, which denied the existence of any fundamental reality.

Second, relativity theory was a mathematical construct, and Einstein knew this, so he continued to insist: "Reality was the real business of physics," and he urged physicists to continue their search for a causal understanding of the realities around them, albeit they did not listen to his advice.

Einstein was unable to achieve causal understanding, and in its absence he was limited to the mathematics of relativity theory. We will later see that in 1939 he relied on the equations of relativity to conclude a black hole could not be a singularity, a conclusion which physics refused to accept. However, observation of pulsars today demonstrates Einstein was right, as will be explained.

It is wrong to think Einstein was omnipotent, but it is also not smart to disregard his thinking. It is noted that his refusal to accept singularities was published in 1939 in the middle of the last twenty-five years of his life, which is when his biographer, Abraham Pais, concluded he might as well have gone fishing. So Pais mostly succeeded in labeling himself a fool, an evaluation he cannot avoid.

Mallove concludes his article with the comment . .we must begin anew to correct it (physics), with arduous experiment and new theory." That is fine: but what about correcting it by recognizing existing observations and existing theories?

Since we are reconsidering Einstein, let us start by considering some of Mallove's comments about Einstein.

Mallove states: "Physicists grant Einstein full credit for having abolished, at least while his influence has reigned, the pervading 'luminiferous aether' which was the medium for the transmission of light waves—universally accepted in the nineteenth century." This is not fair. This writer understands Einstein himself insisted: "There has to be an ether because, if there were not, there would be nothing to propagate light." What other physicists did with Einstein's work is their business. It is inappropriate to present this situation not from what Einstein himself did, but instead from the perspective of what others gave him credit for.

Einstein's relativity theory provided a mathematical construct of the gravitational field, so one can work with the mathematics and ignore the presence or absence of an aether. On the other hand, to the extent a mathematical construct proves to be valid, and relativity theory has correctly predicted some of the facts, then that construct must mathematically define some physical reality. There is nothing other than the aether to provide that reality. This leaves the question of what that aether might be, and one should note our nature provides no substance other than the substance of energy.

This writer pursued the causal analysis which Einstein insisted upon and has been able, among other things, to deduce the aether structure around a gravitating mass and to figure out how that structure was provided. This is what Einstein needed to give physical reality to his mathematically defined gravitational field. That aether structure explains the actions of gravity and shows exactly where the mathematical construct must end its validity. But where validity ends one can expect to encounter important error: and we find the equations of relativity provide the wrong answer. One should also expect that wrong answer to be revealed by observation and to create enormous problems. This is the fact!

More particularly, relativity theory has its basis in actions which take place in and around our solar system where almost all the mass is in the center of the system. But that theory is now extended to the galaxy, where most of the mass is in orbit around the center of the system. This orbiting mass carries the aether medium with it to a considerable extent, an action which does not take place in our solar system. As a result, the outer suns in our own and other nearby

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galaxies move as fast as, or faster than, other suns positioned much closer to the galactic center. So Kepler's law, which is slavishly followed in our solar system, does not appear to function in the galaxy. But Kepler's law makes sense and must be followed, so relativity theory has provided the wrong answer.

This error now persuades astrophysics to speculate on the presence of unseen mass and conclude most of the matter around us is dark, refusing to interact in any way other than by gravitation. No particle known to man can do this, so for this and other reasons dark matter does not and cannot exist.

This writer's texts establish that all we need do is recognize inertia to be motion with respect to the energy continuum filling space. When the motion of the energy continuum around the galaxy is taken into account and used to convert observed velocity into inertial velocity, Kepler's law applies to the galaxy as well as the solar system, and the need for dark matter is eliminated.

Mallove shifts from Einstein to Stephen Hawking, noting his "radiating black holes" had also catapulted him to sainthood in physics. He suggests this conclusion is "virtually mystical (unproved but highly mathematized. . ." Well, it is highly mathematized, but it is not unproved. To the contrary, it has been *disproved,* but Mallove and astrophysics are unaware of this. The Hawking radiation constitutes a central point in modern cosmology, being relied upon to conclude the massive black holes in the centers of galaxies are progressively losing mass. This conclusion allowed cosmology to insist quasars were powered by massive black holes which have lost mass with time to form the normal galaxies around us. But what about the observations?

More particularly, R.C. in *Science News* (Vol. 157, p. 235, April 8, 2000) ignores the standard explanation of quasars, as noted above, and states: "A new study offers the first direct evidence that supermassive black holes grow along with the galaxies they inhabit."

Just what is the evidence under consideration? *Science News* states:

> . . .Michael R. Merrifield of the University of Nottingham in England and his colleagues sought galaxies spanning a range of ages. In this way they could determine how black holes that lurk at the hearts of these galaxies evolved over time.
>
> To measure galactic age, the astronomers analyzed the color and intensity of starlight. . .If a galaxy isn't in the throes of starbirth yet is radiating strongly at the blue end of the spectrum, it's likely to be relatively young.
>
> Merrifield's team found that Andromeda and 22 other nearby galaxies believed to house central black holes range in age from 4 billion to 12 billion years. Moreover, the researchers determined that the lightest black holes reside in the youngest galaxies, and the heaviest ones in the oldest.

To put these observations in perspective, this writer, since 1980, has presented a universe cycle theory which demanded black holes grow with time. He immediately recognized this conclusion was inconsistent with Hawking's black hole radiation and the cosmology theory based thereon. So his theory was ridiculous when initially presented because everyone knew black holes lose mass with time. But subsequent observation has proved the established conclusion was wrong and the universe cycle theory was correct.

One may suggest this writer is picky when he insists Mallove was not correct in terming the Hawking radiation to be unproved, but there is a vast difference between a mathematical conclusion which is "unproved" and something which observation demonstrates is wrong. It is the simple difference between possible theoretical disagreement and being forced to face up to actual observation.

As to the Big Bang theory, Mallove suggests: "Relativity allowed such probable fictions as Big Bang cosmology and 'black holes' to exist—if there is no space-time, only time and space, then there is no possibility of expanding space and time from a singularity at the 'beginning of time.'" The quoted assertion lumps several problems together, and we shall try to separate them.

First, what relativity "allowed" and what it *required* are two different things. Einstein should be faulted for what his theory required, but not for what others did with it. Relativity does not require time to start with an explosion, and that concept is manifestly a wild and unwarranted speculation.

Second, Big Bang cosmology is not merely a "probable fiction," but is instead clearly disproved in many different ways. Indeed, almost all of its predictions are inconsistent with what has been observed. In contrast, all of this writer's universe cycle theory predictions have proved to be correct, and many of these were clearly inconsistent with what the Big Bang theory demanded at the time. Again, there is a vast difference between something which is a probable fiction and something which is established to be inconsistent with many observations in different directions.

Third, black holes are real for the simple reason that many of these have been found and carefully examined, albeit not with light emitted from the hole because light cannot escape the hole. When one wants the established scientific community to respect one's efforts, it does not help to label something a "probable fiction" when there is ample observational proof of its reality. Thus, in every nearby galaxy we can see the rapid motion of objects near the center of the galaxy, which establishes a very large mass is present to induce that motion. But when we then look at the galactic center we find only an accretion disk and no central object. If light could escape this central object we would see it, just as we see neutron stars within their surrounding accretion disks.

Moreover, high speed jets are seen to roar away from neutron stars, black holes, and this central unseen object in both polar directions. The black hole of relativity theory functions because gravity is supposedly so strong from the postulated singularity that it functions in a ballistic manner to prevent anything from escaping the hole. But don't blame Einstein for this, for he strongly objected to the conclusion a black hole was a singularity, as noted previously.

But these polar jets are very peculiar, and observation now establishes that large amounts of material at the inner portion of the surrounding accretion disk can periodically fall into the hole, disappearing from view as it falls. It is only shortly after this has happened that polar jets are seen to blast out into space. As stated in *The Washington Post* in

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January 1998: "High speed jets erupted immediately after blobs of this infalling material seemed to disappear." So fast-moving particles and gravity escape the hole even though light does not. These jets and their manifest peculiarities require a different analysis of the structure and action of black holes, as provided by this writer. That analysis must show how it is light cannot escape the black hole while projectiles and gravity do escape. It must also explain how these jets are independent of the accretion disk, how they are so narrow and retain that narrowness as they extend into remote space, how these fast-moving jets issue low-energy radiowaves, and how they contain large amounts of unionized atoms and molecules despite their immense speed which would normally cause complete ionization. No substitute for relativity theory can be accepted if it does not resolve these problems!

This brings us back to the concept of a singularity, and one should now recall it was Einstein who, in 1939, used his own equations of relativity to conclude that collapse to a singularity was not possible. Oppenheimer and physics did not agree, and it is thought the essence of the situation is Einstein had a better understanding of our nature. Mathematics involves more than manipulating equations; one must understand what the mathematics signifies. Otherwise, conclusions based on that mathematics may not be correct.

This writer's aether-based causal analysis concludes singularities are not possible. Since observation corroborates that view, Einstein was right after all. The point raised here is that it is unseemly to blame singularities and theories which include them on Einstein when he insisted they could not form—and was damned for that conclusion. As noted previously, he reached that conclusion while his biographer considered he was essentially brain-dead.

An important aspect of the conflict between existing physics and this writer is the concept that a black hole is a singularity, while this writer concluded it was a particulate entity constituted by a nucleus of enormous size. This issue comes to a head when we consider polar jets. Existing theory relies on the accretion disk and magnetic action, albeit magnetic action is quite different than what is needed because it moves material into the magnetic field instead of away from it, and because magnetic lines of force spread out while these jets remain remarkably narrow as they extend into remote space.

The issue is resolved factually by the jets emitted by the pulsar in the Crab nebula, which trace out a conical pattern 30 times per second. So these jets are never at a right angle to the accretion disk, and they are constantly at a different angle with respect to this disk. This forces the jets to be independent of the disks. Since the pulsar ejects polar jets and we can see this object is a neutron star and not a singularity, and since all polar jets have the same peculiar properties, this establishes that both black holes and neutron stars provide polar jets as a result of their common structure. This corroborates Einstein's 1939 conclusion and this writer's causal analysis.

Mallove does not like Einstein's postulate that the velocity of light is a constant when measured by all observers. It is an obviously uncomfortable postulate because we all know a thrown rock will hit us harder if we are running toward it rather than running away from it. But from the standpoint of causal analysis, Einstein's postulate has obvious merit.

In causal analysis, light propagates through the energy continuum filling space and massive objects, like the Earth, capture that continuum and carry it along with the motion of the Earth. So when light reaches us it doesn't matter how fast it was moving before it neared the Earth, for when it gets here it must propagate at a natural velocity through a medium which is largely stationary with respect to the Earth, albeit there is a slow movement into the Earth. The same is true for any observer positioned on any gravitating object. This is why inertia near the moon is with respect to the moon and not with respect to the Earth, as it is near the Earth. One reason Einstein's analysis may frequently provide a correct answer is because its apparently silly postulates conform with physical reality.

Mallove suggests "most alternatives to Einstein's relativity theories seem to focus on mathematical alterations." But the true test of any theory is a simple one. Find a problem where we don't know the answer, then make a prediction based on the new theory which is inconsistent with the conclusion one would reach based on the accepted theory. Then wait for experimental verification of the apparently incorrect prediction. Without this one has nothing more than argument With it the new theory must supplant the old one. If this is a stringent test, it is nonetheless the test which science has always applied. When one reads the various views contained in the subject issue of *Infinite Energy* and the issue to follow, all one need do is look for the unlikely predictions and then note the subsequent observations. If these are not present, the authors have not passed the test.

This writer's theory was published in the 1980s and was inconsistent with established thinking on every point. Indeed, a summary of it was published in the September 3, 1994 issue of *Science News* at page 147. To illustrate one area of inconsistency, the universe cycle theory demanded that black holes not be a singularity, which in theory they had to be, and these holes had to grow more massive with time when existing theory demanded they evaporate and grow less massive with time. Forget theory. Observation now demonstrates black holes cannot be a singularity and they do grow with time. This is only one of several direct inconsistencies between the universe cycle theory and established thought.

To illustrate, the universe cycle theory was alone in predicting gamma-ray explosions of immense force had to be taking place in remote space. All of astrophysics was then convinced these explosions were within our own galaxy and of relatively little power. We now know this writer's prediction was correct. No wonder he insists that if any theory is to be respected, one must show yesterday's outrageous predictions have proved to be correct.

Lastly, Mallove recognized "Einstein's rapid rise" following the 1919 eclipse observations, and this writer has been involved with this subject matter, as summarized below.

Long before Einstein, von Soldner had calculated the extent to which the Sun's gravity should deflect a beam of light passing close to the Sun, and physics had accepted that calculation. Einstein used his relativity equations to calculate the extent of deflection in two different ways, in both instances obtaining the same deflection angle as von Soldner. Einstein added these two calculated values to double the deflection. The 1919 eclipse observations were not precise enough to determine that the deflection was exactly doubled, as Einstein suggested, but it was roughly doubled,

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and this shocked physics and elevated Einstein.

This writer studied Einstein's two different calculations and has never understood how Einstein had calculated two different things. When two different calculations produce exactly the same value, the presumption is you have calculated the same thing in two different ways. Nonetheless, Einstein added his two calculated results, and the 1919 eclipse observations clearly proved the actual deflection was much greater than von Soldner had calculated. It is very hard to argue when someone's broad prediction in the teeth of what everyone else thought was so is subsequently found to be correct!

What persuaded Einstein to add his two calculated values? This writer concludes that, just like the issue of whether relativity equations allowed collapse to a singularity, Einstein allowed his understanding of our nature to direct his conclusions. In this instance, light propagates through an energy continuum, and Einstein may have allowed analogy to the propagation of sound to direct his thinking, just as it directs this writer's thinking.

Sound propagates through air at a natural velocity. Light also moves through space at a natural velocity. The existence of a natural velocity for light confirms it is propagating through some medium. The much greater speed of light suggests the medium which propagates light is continuous, in contrast with the particulate nature of air which slows propagation through that medium.

Continuing the analogy between the propagation of sound and light, when the density of air is reduced, as it is above the surface of the Earth, the velocity of sound decreases. This suggests the speed of light in a vacuum is not an exact constant, but should be slowed whenever light moves through space containing a reduced density of the energy continuum propagating medium. Also, as the density of air decreases, it becomes progressively more difficult for sound to propagate, and when the air density is low enough, as in a vacuum, sound does not propagate at all. This suggests light will also be unable to propagate when the density of the energy continuum becomes insufficient to enable propagation of the light wave.

How do these various suggestions flowing out of the analogy between the propagation of sound and light interface with known actions in the nature around us?

Light has wave as well as particle characteristics. Some of its characteristics suggest light is a particle, but other of its characteristics, such as the interference patterns produced in the two-slit experiment, suggest wave action. To illustrate wave action, when a beam of light moves through a prism, its path is bent as the light wave is slowed as it moves through the glass of the prism. The first portion of the light wave which encounters the glass of the prism is slowed first, and then the remainder of the light wave enters the prism and is slowed. Since the first portion of the wave is retarded more than the remaining portions of the wave, this tilts the wave and bends the beam of light, the phenomenon being known as refraction. Could this tilting of the light wave to deflect the photons carried by that wave take place in space when a beam of light passes close by the surface of the Sun?

To answer this question we must consider mass and gravity.

Particles of matter are formed when a high-energy photon releases its energy. Since photons move at light speed when they release their energy, that energy must have been moving at light speed when it formed particles. With nothing to stop this motion, logic suggests the energy constituting a particle continues to move at light speed in that particle. It is this motion of the energy moving around the particle which provides the resistance to acceleration which is mass (as Newton defined it). The motion of a spinning top resists the accelerating force of gravity, and analogy to a spinning top suggests a particle obtains its resistance to acceleration in the same manner.

Nothing is perfect, so one can expect the energy motion will slow, probably at a rate so small as to be imperceptible. To persist in space the particle's energy content (its length), velocity, and motion path must remain in balance, so as the velocity slows additional energy is absorbed from the surrounding space to maintain this balance.

This minuscule absorption of energy produces gravity when the energy absorption of many particles accumulates to produce a significant reduction in the energy density in and around a gravitating object. The reduced energy density propagates away by contact response to provide a gradient in the energy density and pressure extending from a low level near the object to a greater level in space remote from the object. Anything within this energy gradient is accelerated toward the low energy density and pressure near the gravitating object, much as a rotor blade in a turbine is accelerated toward low pressure.

This discussion forces two conclusions. First, the density and pressure of the energy continuum close to a gravitating object, like our Sun, is reduced, and the energy density and pressure increase as one moves away from the mass which created the field. Second, the greater the mass, the greater the gravity and the more that gravity will decrease the energy density and pressure close to the mass under consideration.

These two conclusions demand that light passing close to a gravitating object be refracted. This is because the reduced energy density close to the Sun will cause the light wave to move more slowly near the Sun than it will farther away from the Sun where the energy density is higher. This is the same greater slowing of one portion of a wave which tilted the plane of the light wave as it passed through a prism to cause refraction.

Since the light wave propagates at a right angle to its plane, the refractive tilting of the wave close to the Sun deflects the photons carried by that wave exactly as happens when a light wave passes through a prism, and this will increase the deflection caused by gravity.

It seems clear to this writer that Einstein, who recognized that light propagated through a medium filling space, may have drawn an analogy to the propagation of sound in air, just as this writer does, and concluded there had to be a refractive addition to the deflection of light produced by gravity. When he then made his two different calculations of that deflection, he knew something had to be added to the deflection produced by gravity, so he added the second calculated value to the first even though it is not at all clear the second calculation was anything more than a different calculation of the same gravitational deflection which had been calculated in the first calculation.

Einstein was also involved through his theory of relativity in the nature of a black hole, and the history of black hole theory interfaces with the propagation analogy under dis-

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cussion. But that history has recently been distorted. In 1996 Jeremy Bernstein published an article in *Scientific American* in which he tore Einstein apart for his 1939 conclusion that his relativity equations did not allow black holes to be singularities. Bernstein concluded Einstein had suggested black holes did not exist, in conflict with present knowledge. Bernstein then noted Oppenheimer's 1939 paper, in which Oppenheimer relied upon these same relativity equations to reach an opposite conclusion. This writer showed Bernstein's paper was without merit because the portion of Einstein's paper quoted by Bernstein did not suggest Einstein had concluded black holes do not exist, but only that they could not exist as a singularity.

Curiously, existing black hole theory suggests that above 1.3 solar units (one solar unit is the mass of our Sun) a black hole is supposedly formed as the electrons are squashed by the excessive gravity in a cooling sun. But when we review the evidence relating to objects which are clearly black holes, none of these have a mass less than 4 solar units. This suggests the calculation may be incorrect.

Let us consider what a black hole should be like. The theoretical concept, broadly stated, is that gravity is a function of mass, so when there is enough mass providing a very great gravity, and when that gravity is concentrated into a sufficiently small object, then that gravity might function to prevent the escape of light. But that broad concept does not require the object of great mass to be a tiny point-like singularity, but only that the object of great mass be very small. This generalized statement ignores mechanism.

When we maintain the density of an object as the mass increases, the radius will increase very little (with the cube root of the mass). So as the mass increases there is very little increase in size because the mass increases linearly with the volume while the radius increases with the cube root of the volume. The result of this geometry is that a large increase in mass causes very little increase in size. This forces the size to remain small even though the mass increases greatly, and gravity increases in proportion to mass. Finally, the increasingly concentrated gravity produced by increasing the mass with little increase in size will reduce the energy density to where it interferes with the propagation of light. But that low density would not interfere with the ejection of material in a jet.

Conventional theory employs a ballistic analysis in which a black hole forms when the gravitational acceleration equals the velocity of light. But this suggests particles will also be unable to escape the hole, and polar jets do escape!

So black holes are real, but the mass required to form them is greater than calculated by existing theory because these holes are not singularities and are not formed by the collapse of electrons. Instead, a black hole is formed in the same way as a neutron star, except a more massive nuclear structure is formed with little increase in size. The inability of light to escape the great gravity of the hole has nothing to do with any escape velocity, but by analogy to the propagation of sound is instead based on a reduction in the density of the energy continuum to where light waves are unable to propagate.

When we understand that black holes prevent the escape of light by providing too low an energy density to permit light propagation, then we can go back to our analogy to the propagation of sound and note that a vacuum prevents the propagation of sound, but it does not prevent the transmission of a projectile.

This discussion should clarify Einstein's relativity contribution. Alternate theories must make different predictions and be corroborated by subsequent observation. But at least they must explain existing observations, such as those relating to polar jets discussed herein. ❑❑❑

About the Author

Mr. Gulko was bom in 1926. After serving in the Army Air Corp in World War II, he obtained a degree in chemical engineering and then spent four years as an Examiner in the United States Patent Office. Upon obtaining a degree in law, he passed the Virginia Bar and entered the private practice of patent law, representing diverse clients from 1952 to 1988. He then retired to devote his time to fundamental studies in physics and astrophysics. Starting in 1980 he published thirteen texts, three of which are devoted to fundamental physics, the remainder being directed to the astrophysics generated by the physics. He has made contributions in every aspect of physics, including electron structure and action, the structure and action of hydrogen, and the configuration of the electrons around atoms. He also established a progression of nuclear structures for all the elements and his universe cycle theory has been the only one to correctly predict what would subsequently be observed in space. He is presently working on the use of nuclear forces in the formation of fractional hydrogen using electron beam technology.

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From Water to "Gasoline"?

Robert A. Nelson*

Wouldn't it be nice if we could burn water for fuel? Think of all the money we could save, since water costs only 25 cents a gallon at the store this week, and it's always free from the ocean.

It's a wet dream that some have *claimed* to have fulfilled. These are some of the most astonishing claims ever made in the "free energy" field. The stories are fascinating in their own right—not because they are especially believable. The most recent instance occurred in 1996 at the Indian Institute of Technology (ITT), where thirty-year-old Ramar Pillai demonstrated the alleged conversion of water to a hydrocarbon fuel by mixing it with a secret herbal formula he had discovered. Scientists were understandably amazed by the experiment, which was organized by ITT chemist N.K. Jha. "It is incredible but true," Jha said.

About two ounces of leaves and bark were boiled in a liter of water, cooled, and a small amount of salt, citric acid, and secret chemicals were added. About a pint of combustible liquid that smells and burns like kerosene was produced within thirty minutes. The National Chemical Laboratory (Pune, India) analyzed the substance and found it to be a pure hydrocarbon with a boiling point of 170°C. The new fuel is more efficient than gasoline, and produces no sulfur exhaust. Researchers at the Indian Institute of Petroleum confirmed the reality of the process.

Ramar Pillai was granted twenty acres of land on which to cultivate the marvelous bush, and he applied for patents on the process. Then Pillai was accused of being a charlatan; allegedly he had added oil to the process by trickery even as scientists watched him perform the experiment.

In 1916, Louis Enricht announced that he had invented "a substitute for gasoline that can be manufactured for a penny a gallon." As a demonstration, Enricht allowed reporters to inspect the empty gas tank of an automobile. The reporters also tasted the water that Enricht then poured into the tank. He added a green pill, started the car, and gave the reporters a ride around Farmingdale, Long Island. William Haskell, publisher of the *Chicago Herald,* investigated Enricht's claims. He wrote:

> I examined the entire engine and tank. I even tasted the water before the mysterious green pill was dropped into the tank. Then I opened the petcock and examined the liquid, which now tasted like bitter almonds. I also tasted the liquid at the carburetor which was the same. I was amazed when the auto started. We drove it around the city without any trouble.

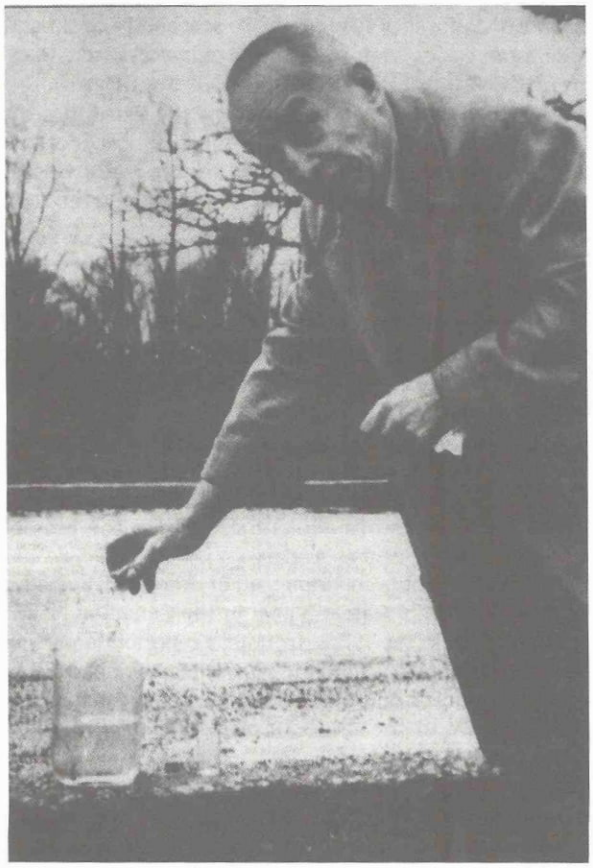
A few days later, however, reporters learned that Enricht had been indicted for fraud in 1903, and had been involved in other phony schemes. Despite his lack of credibility, Enricht was able to get Benjamin Yoakum to finance him and organize the National Motor Power Company. Investigators from the British Army were given a demonstration, and they reported that, "The car operated as expeditiously and efficiently as it would have on gasoline."

The deal soured, however, and Yoakum sued Enricht, who was forced to open a safe deposit box in which he supposedly had placed the formula and a sample of the substance. It wasn't there, and the National Motor Power Company folded. Enricht eventually was convicted of another fraud (extracting gasoline from peat) and served several years in Sing Sing prison.

In 1917, John Andrews approached the U.S. Navy with his claim that he could convert fresh or salt water into a fuel with the same power as gasoline. The chemical costs were about 2 cents/gallon.

Andrews was allowed to demonstrate his invention at the Brooklyn Navy Yard, where a motor boat was fitted with a dynamometer for the test. Commander Earl P. Jessup, who was Captain of the yard, said:

> We gave Andrews a bucket of water drawn from the Navy Yard [fresh water] hydrant by one of the yard attaches. He got into his car with a gallon can which we inspected and found to be empty and a little satchel he carried with him. In about a minute he handed out the filled can which I personally carried to the open fuel tank. While pouring the liquid into the tank, Andrews held a lighted cigarette close to the liquid, which did not ignite. That showed it



Guido French demonstrating Mota.

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> was not gaseous or inflammable at that part of the demonstration, which to me was most important. The engine caught just as quickly as it would have done with gasoline, and after a moment's adjustment of the carburetor, it settled down to its work, developing 75% of its rated horsepower, a remarkable showing with any fuel with so slight a readjustment of the carburetor.

In a second test, Andrews was put in an empty room with no possible way to get rid of the bucket of salt water with which he had been supplied, except to empty it into his one-gallon gas can. Commander Jessup said:

> In a minute he emerged with the can filled, and the engine again used it up, no difference being noted between the salt water and fresh. Besides myself, Rear Admiral G.E. Burd, the Industrial Manager of the yard, was present and with the precautions we had taken—our own Navy engine, tank and carburetor and our own men supplying the water—there was no possibility of deception. . .From a military viewpoint, it is almost impossible to visualize what such an invention means. It is so important that we have hurried an officer to Washington to make a report to the navy Department. It is obvious that Andrews has discovered a combination of chemicals which breaks down water to a form that is inert until mechanically vaporized by the carburetor, when the spark causes it to burn as gasoline burns.

Walter Meriwether, the Navy editor of the *New York World,* met with Andrews at his home in McKeesport, Pennsylvania. Andrews was extremely paranoid. He said:

> Somebody poisoned my watchdog last week. . .The only reason my dog was poisoned was so somebody could get at me more easily. I am being followed everywhere, day and night. A lot of people know about my invention—how it will put every oil company in the world out of business. Two cents a gallon for a substitute as good as the best they can refine? I tell you, my life is not worth that [snapping his fingers]! Think of what my invention means to nations at war.

Meriwether offered to arrange for a thorough test of his invention with the Navy Department in Washington, D.C., and Andrews accepted his help. Meriwether managed to arouse the interest of Secretary Josephus Daniels, who said: "Tell the man to come on at once; I will have a submarine and airplane detailed and ready for him on his arrival."

Meriwether telegraphed Andrews, but received no reply. He returned to McKeesport, but Andrews could not be found. Meriwether then accompanied the police to Andrews' home, where they found signs of a violent struggle in the ransacked house. No trace was found of Andrews.

But Andrews had not been kidnapped or murdered; he had simply reported back to his seaman's post in the Canadian Navy. He returned to the U.S. in the 1930s. In 1942, a reporter named James Kilgallen found Andrews living on a farm near Library, Pennsylvania. Andrews said that he had forgotten the formula.

Another version of the Andrews mystery states that he was found murdered in his home in 1937, and all of his notes and supply of green powder were missing. His sister allegedly took the notes and fled to Scotland, where she too was murdered only a year later. The eminent journalist Tom Valentine, who has written numerous articles about suppressed technologies, once received a phone call from a man who claimed to be John Andrews, Jr. His innuendos could not be proven, of course: "My aunt was killed, and then some of my relatives suddenly got rich, and I believe the process for making the powder is known, and the people who know are the Phillips Petroleum Company."

The next person to demonstrate the conversion of water to fuel was Guido Franch, a former coal miner who tried for nearly fifty years to find financiers for his product. He too used a green powder to allegedly turn water into 105-octane fuel. He called it "Mota," which is atom spelled backwards.

Franch demonstrated Mota hundreds of times, but never produced it commercially. He did, however, sell about 3000% of his rights to interested investors. In 1973, Franch was subpoenaed to appear in Chicago's Federal Circuit Court "with any records relating to the purchase or the proposed purchase of any fuel, fuel powder, or fuel formula in your possession." He demonstrated his Mota transmutation in the presence of judges William Bauer and Philip Romiti, who believed what they saw, and Franch was acquitted of charges of fraud.

The alleged fuel is produced with one pound of the reagent in 50 gallons of water. It burns clean and leaves no residue. In one demonstration with a lawnmower, it ran for about fifteen minutes on a small amount of Mota-treated water. An equal amount of gasoline lasted only three minutes. Mota fuel is very sensitive to sunlight, which will turn it back to water with a white powder residue.

Gary Bolz, a consultant on carburetion and fuel engineering, was able to test Mota with the help of chemists at Michigan State University and Havoline Chemical Laboratories. Bolz stated:

> The granules are dark olive green. As they enter water, they dissolve in a string of green, which begins to spread fiber-like throughout the water. As the water begins to react, there is a swirling effect. Reaction is complete in a few minutes. If the crystals are mixed in 1:1 ratio with water, the resulting fluid is highly explosive and can be detonated by a small shock. But it isn't shock-sensitive when mixed at a normal ratio of one ounce of powder per half gallon of water. The finished fuel is lighter than water.

Franch claimed that the manufacture of Mota was taught to him and others in 1925 by a German scientist named Alexander Kraft, who died in 1941. One pound of the green crystals can be produced from 25 pounds of coal at a cost of about $100.

Franch received about $100,000 from small investors over a period of forty years. He used that money to live on, and never manufactured any Mota. He received several serious offers from major investors, but his financial demands were unreasonable and nothing practical ever came of his demonstrations and negotiations.

It appears that we will be obliged to continue buying and burning gasoline until some benevolent genius rediscovers the secret of extracting green crystals from coal, and deigns to share it with us pobuckers, assuming that such a "secret" actually exists! ♦♦♦

About the Author

Robert Nelson is the owner/operator of Rex Research, established in 1982 to collect and disseminate hard-to-find information about unconventional technologies.

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Problems Reported at Nuclear Plants

Jed Rothwell

This has not been a good season for the nuclear power business. In March, a large hole was discovered in the Davis-Besse plant in Ohio. Boric acid in the cooling water corroded the reactor vessel lid. The lid is six inches thick. The hole is about six inches wide, and it penetrated five and a half inches into the metal, leaving only about a half inch of steel to contain the cooling water, which is pressurized at 2,200 psi. If the hole had broken through before it was discovered, thousands of gallons of cooling water would have spilled inside the containment building. It could have been worse. The *New York Times* reported, "some experts fear that if rushing steam and water damaged thermal insulation on top of the vessel, the pipes could clog. In that event, the reactor might have lost cooling water and suffered core damage—possibly a meltdown—and a larger release of radiation, at least inside the building. . ,"

Nuclear Regulatory Commission (NRC) officials expressed surprise and said they had never seen so much corrosion in a reactor vessel, and never imagined there could be so much. They said, "[such corrosion] was never considered a credible type of concern." Another hole was discovered in April.

The NRC criticized the plant operators, saying they should have seen the damage four years ago. The plant operators observed boric acid deposits on the top of the reactor vessel, but they did not realize this was abnormal and a sign of trouble. The plant operators hope to repair the hole by welding a patch over it, but the NRC thinks more extensive repairs will be needed.

In March the Southern Company declared an alert at the Hatch nuclear power plant in Georgia, after electricity powering the control panel mysteriously cut off. After a week, control panel power was restored, but in a written statement officials admitted they still do not know why this happened, or how they managed to fix it. This was similar to a 1978 incident in the Rancho Seco plant in California. Someone accidentally dropped a flashlight bulb into the control panel, which short circuited the panel and cut off control of the reactor for sixty-nine minutes. (See "Some Thoughts about Nuclear Fission Power Reactors," *IE* #40.)

The *New York Times* reported grave problems at the Indian Point plant near New York City. In 2000, an accident resulted in the discharge of 20,000 gallons of radioactive water. The reactor was closed for nearly a year. Officials said there was no threat to public health. The plant has a troubled history. Four out of seven control room crews failed to pass their annual qualification exams. An electric failure in the turbine caused a reactor scram. The reactors are located in the most densely populated area in the U.S. Twenty million people live in the reactor danger zone. The NRC gives Indian Point the worst safety rating of any U.S. reactor. In a 1982 report, the NRC concluded that a meltdown at the Indian Point Reactor 2 could kill 46,000 people and injure 141,000 others in the short term, with many more long term deaths from cancer. The *Times* says, "The potential casualties from a meltdown at Indian Point 3 were even worse."

After the September 11 terrorist attack, the government assured the public that nuclear plants are designed to withstand the direct impact of a fully loaded passenger jet. It released a Defense Department video showing a test of a fighter jet slamming into a six-foot thick section of reinforced concrete, which it claimed was similar to a reactor containment building wall. The jet disintegrated and little damage was done to the wall. However, this was not a valid test, because a fighter jet weighs much less than a passenger jet, and the section of wall in the video was sitting on blocks. It was visibly pushed back by the impact, absorbing some of the energy. A real reactor wall would have no place to move. Recently, the government admitted that nuclear plant containment buildings would not be able to withstand a direct airplane impact after all. Only five out of 103 plants were designed to withstand impacts, and they were designed decades ago when aircraft were lighter and slower.

One of the September 11 hijacked airplanes flew very close to the Indian Point power plant. ♦♦♦

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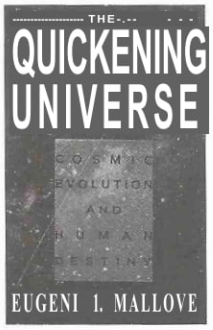

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Compiled by Eugene Mallove

U.S. Navy Report Supports Cold Fusion

A new official report prepared by the U.S. Navy strongly supports cold fusion research and its funding:

TECHNICAL REPORT 1862, February 2002
Thermal and Nuclear Aspects of the Pd/D_2O System

It is a public document with unlimited distribution. Because of its importance, we are posting below some of the introductory material in each of the report's two volumes.

The full report is available on the internet in two electronic formats, thanks to the work of Mathias Bage:

http://bitops.com/~mathias/trl862/trl862-volume1.pdf

http://bitops.com/~mathias/tiT862/trl862-volume2.pdf

http ://bitops,com/~mathias/tr1862/html/volume2/

We wish to highlight a crucial statement from the Foreword to the report:

"As I write this Foreword, California is experiencing rolling blackouts due to power shortages. Conventional engineering, planned ahead, could have prevented these blackouts, but it has been politically expedient to ignore the inevitable. We do not know if Cold Fusion will be the answer to future energy needs, but we do know the existence of Cold Fusion phenomenon through repeated observations by scientists throughout the world. It is time that this phenomenon be investigated so that we can reap whatever benefits accrue from additional scientific understanding. It is time for government funding organizations to invest in this research.

Dr. Frank E. Gordon, Head
Navigation and Applied Sciences Department
Space and Naval Warfare Systems Center, San Diego"

Again, because of its national and international significance, we present here the initial material of Volume 1 in its entirety:

TECHNICAL REPORT 1862, February 2002

Thermal and Nuclear Aspects of the Pd/D_2O System

Volume 1: A Decade of Research at Navy Laboratories

S. Szpak, P. A. Mosier-Boss, Editors

Approved for public release; distribution is unlimited SPAWAR Systems Center San Diego, SSC San Diego San Diego, CA 92152-5001

P.A. Miller, CAPT, USN Commanding Officer R.C. Kolb, Executive Director

Administrative Information

The work described in this report was performed for the Office of Naval Research through the collaboration of Space and Naval Warfare Systems Center, San Diego (SSC San Diego); the Naval Air Warfare Center, Weapons Division, China Lake; and the Naval Research Laboratory (NRL). Released by G.W. Anderson, Head, Applied Research and Technology Branch, Under authority of R.H. Moore, Head, Environmental Sciences Division.

Contributing authors (in alphabetical order): Dr. Pamela A. Mosier-Boss (Spawar Systems Center San Diego), Dr. Scott R. Chubb (Naval Research Laboratory, Washington, DC), Professor Martin Fleischmann, F.R.S.,United Kingdom, Dr. M. Ashraf Imam, Naval Research Laboratory,Washington, DC, Dr. Melvin H. Miles, Department of Chemistry, Middle Tennessee State University, Murfreeboro, TN, Dr. Stanislaw Szpak, San Diego, CA.

Foreword

Twelve years have passed since the announcement on 23 March 1989 by Professors Fleischmann and Pons that the generation of excess enthalpy occurs in electrochemical cells when palladium electrodes, immersed in D_20 + LiOH electrolyte, are negatively polarized. The announcement, which came to be known as "Cold Fusion," caused frenzied excitement. In both the scientific and news communities, fax machines were used to pass along fragments of rumor and "facts." (Yes, this was before wide spread use of the internet. One can only imagine what would happen now.) Companies and individuals rushed to file patents on yet to be proven ideas in hopes of winning the grand prize. Unfortunately, the phenomenon described by Fleischmann and Pons was far from being understood and even factors necessary for repeatability of the experiments were unknown. Over the next few months, the scientific community became divided into the "believers" and the "skeptics." The "believers" reported the results of their work with enthusiasm that at times overstated the significance of their results. On the other hand, many "skeptics" rejected the anomalous behavior of the polarized Pd/D system as a matter of conviction, *i.e.* without analyzing the presented material and always asking "where are the neutrons?" Funding or research quickly dried up as anything related to "Cold Fusion" was portrayed as a hoax and not worthy of funding. The term "Cold Fusion" took on a new definition much as the Ford Edsel had done years earlier.

By the Second International Conference on Cold Fusion, held at Villa Olmo, Como, Italy, in June/July 1991, the altitude toward Cold Fusion was beginning to take on a more scientific basis. The number of flash-in-the-pan "believers" had diminished, and the "skeptics" were beginning to be faced with having to explain the anomalous phenomenon, which by this time had been observed by many credible scientists throughout the world. Shortly after this conference, the Office of Naval Research (ONR) proposed a collaborative effort involving the Naval Command, Control and Ocean

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Surveillance Center, RDT&E Division, which subsequently has become the Space and Naval Warfare Systems Center, San Diego (SSC San Diego); the Naval Air Warfare Center, Weapons Division, China Lake; and the Naval Research Laboratory (NRL). The effort's basic premise was to investigate the anomalous effects associated with the prolonged charging of the Pd/D system and "to contribute in collegial fashion to a coordinated tri-laboratory experiment."

Each laboratory took a different area of research. At San Diego, our goal was to understand the conditions that initiate the excess heat generation (the Fleischmann-Pons effect) and the search for evidence that indicates their nuclear origin. To eliminate the long incubation times (often weeks), Drs. Stan Szpak and Pam Boss decided to prepare the palladium electrodes by the co-deposition technique. Initially, they concentrated on tritium production and the monitoring of emanating radiation. More recently, they extended their effort to monitoring surface temperature via IR imaging technique and showed the existence of discrete heat sources randomly distributed in time and space. This discovery may prove to be a significant contribution to the understanding of the phenomenon.

At China Lake, Dr. Miles and his collaborators showed that a correlation exists between the rate of the excess enthalpy generation and the quantity of helium in the gas stream. Such a correlation is the direct evidence of the nuclear origin of the Fleischmann-Pons effect.

The research at NRL was directed toward the metallurgy of palladium and its alloys and the theoretical aspects of the Fleischmann-Pons effect. In particular, Dr. Imam prepared Pd/B alloys that Dr. Miles used in calorimetric experiments. It was shown that these alloys yielded reproducible excess enthalpy generation with minimal incubation times (approximately 1 day). The theoretical work of Dr. Chubb contributed much to our understanding of the Fleischmann-Pons effect.

Although funding for Cold Fusion ended several years ago, progress in understanding the phenomenon continues at a much slower pace, mostly through the unpaid efforts of dedicated inquisitive scientists. In preparation of this report the authors spent countless hours outside of their normal duties to jointly review their past and current contributions, including the "hidden" agenda that Professor Fleischmann pursued for several years in the 1980s when he was partially funded by ONR. Special thanks are extended to all scientists who have worked under these conditions, including those who contributed to this report and especially to Professor Fleischmann.

As I write this Foreword, California is experiencing rolling blackouts due to power shortages. Conventional engineering, planned ahead, could have prevented these blackouts, but it has been politically expedient to ignore the inevitable. We do not know if Cold Fusion will be the answer to future energy needs, but we do know the existence of Cold Fusion phenomenon through repeated observations by scientists throughout the world. It is time that this phenomenon be investigated so that we can reap whatever benefits accrue from additional scientific understanding. It is time for government funding organizations to invest in this research.

Dr. Frank E. Gordon, Head
Navigation and Applied Sciences Department
Space and Naval Warfare Systems Center, San Diego

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Thermal and Nuclear Aspects of the Pd/D_2O System

Volume 2: Simulation of the Electrochemical Cell (ICARUS) Calorimetry

Foreword

The calorimetry of any electrochemical cell involves two type of activities: data collection and data evaluation. The required data are the cell potential-time and cell temperature-time series. The evaluation is based on conservation laws subject to constraints dictated by cell design and the adapted experimental procedure.

Volume 2 of this report deals with the modeling and simulation of the Dewar-type calorimeter. It was written by Professor Fleischmann to provide an authoritative discussion of the calorimetry of electrochemical cells. The emphasis is on the interpretation of data and the accuracy of the determination of the excess enthalpy generation via the appropriate selection of heat transfer coefficients. The discussion of the calorimetry of the Dewar-type cells is presented in the form of technical report for a number of reasons, among them: (i) its length would likely prohibit publication in topical journals, (ii) to clarify misunderstandings regarding the principles of calorimetry as applied to electrochemical cell in general and to the cell employed by Fleischmann and his collaborators, in particular.

— S. Szpak and P.A. Mosier-Boss, eds.

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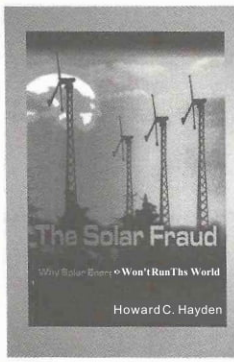
Book Review/



The Solar Fraud: Why Solar Energy Won't Run the World

by Howard C. Hayden
ISBN 0-9714845-0-3
$21.95 Paperback, 222 pp.
Vales Lake Publishing, 2001

Review by Thomas E. Phipps, Jr.

Since Adam, the withered relics of each declining generasD tion have groused that the world is going to hell in a hand basket. (This irreversible deterioration is rather like the increase of entropy: It keeps happening, yet the long-term consequences don't seem to happen. . .rather the contrary.) In my old age I find myself no exception to the rule. It seems to me that in important ways the world has, indeed, gone to hell—and all on my watch. Take almost anything—take education of the young. There's grade inflation, for an outward manifestation. When I compare my mother's yellowing schoolbook and the words she was reading at a most tender age with what high school graduates can't cope with today, I have to shudder. Nowadays the young don't need to read, they have graphics on the Internet; they don't need grammar, they can communicate by Indian sign language; they don't need history, the world began with them. If there are secular changes, who's to complain? Not the teachers—as educators, they need to know how, not what, to teach. Relax, it's OK, Jack, just so everybody feels good. What bothers me is not mainly the drift away from fusty academic standards. . .it's the systematic drift of academia as a whole away from reality. Increasingly, academia presents to my jaundiced eye the appearance of a separate world, floating in air, like Laputa. (Sorry, you'd have to do some reading to know about Laputa.) Higher education has become, all too literally, higher.

The outward token of this floating-off is the phenomenon known as "political correctness." Who would have thought that in this land of the free, with nothing threatening us, nothing compelling us, we would nurture and bring to flower a sub-culture in which everyone salutes certain shibboleths, follows certain leaders, and thrills to certain overpowering, if synthetic, ideals. . .reminiscently of the *Hitler Jugend?* In fact, in today's Germany the militant Greens are the *Hitler Jugend,* sans Hitler—the same genes and susceptibilities slightly displaced in time, burning with the same gemlike flame of dedication to irrational goals. Today's politically correct extremist agenda calls for the trashing of science in the name of science. . .or in any other name that will serve, since rationality is no restraint. Does our society, in the rational view, need energy? If so, in the politically correct view, energy is *bad:* We should feel guilty about consuming so much of it. We should aim to turn back the clock to the hunter-gatherer stage, preferably to vegetarian hunters and gatherers of organically-grown wormy vegetables who eschew pesticides, chew betel nuts, and smoke marijuana. Guilt is one of the keys to a politically correct frame of mind. In academia today, generosity in spreading guilt among the peasantry is a moral obligation. Do I think of today's campus-based assault upon thought-diversity as un-American? Shame on me. . .it's precisely as American as Puritanism. Puritanical conformity, that is, flavored with a lemon-twist of double-talk touting "diversity." The new Puritans, like the old ones (and their descendants, the Abolitionists), know what's best for other people and are determined they shall get it, preferably against their will.

Lawsamussy, how I do run on. I was supposed to review a book. I believe I have it here somewhere. It must have been. . . Howard Hayden's book, that was it, that put the above ruminations in my mind. Professor Hayden has nobly taken up the cudgels in the good fight for energy—for a reasoned, scientifically valid approach to meeting the world's energy needs. Does he offer a panacea, a political agenda, a solution? No, he does something regrettably much more needed by our society. He has taken the first step toward a rational approach: the identification of things that demonstrably *will not* work. This he does as a physicist, one intimately acquainted with the scientific details of the subject and qualified by thirty-two years of teaching physics to undergraduates to put things in straight, simple terms. Specifically, he analyzes in a way any lay person can understand the numerous *solar energy* panaceas that less knowledgeable and less responsible individuals—the Gurus of Greendom alluded to above—have sold to the world's most gullible segment of buyers, the academic public. . .and thence to government agencies that ought to know better, including the muscle behind the environmental protection racket.

In a word, there is just not enough sunlight (luckily for fragile life forms such as our own), not enough solar photons falling per second per square meter of the earth's surface, to begin to meet the energy requirements of even the present day, much less of an energy-hungry future. Contrary claims, drummed into the public by the Gurus, constitute what Hayden calls "the solar fraud". . .and what else should it be called, in all honesty? No amount of wishing will enhance the solar light flux; we have to make do with what there is. Hayden shows that to intercept enough sunlight and convert its energy to useful forms, such as electricity, to meet all of this country's energy needs would require so vast an area of collectors and would wreak such environmental havoc as might divert the attention even of Environmentalists from their tree-frog priorities.

Professor Hayden goes through this drill in exemplary detail. He begins at the beginning, with units. One of the best ways to lie with statistics is to use exotic units, such as acre-feet per rood, or wooly-bear caterpillars per immigrant family, to make whatever political point will not bear more perspicuous exposition. Some years ago a covey of scientists gathered one midnight from the four corners of the earth and agreed on a system of units (SI, the international system), which must have pleased electricians by saving Ohm's law and sticking factors of "c" or "4" into practically everything else. To the world's scientists the word went out, "Like it or leave it." And since no facilities for leaving the planet were provided, everybody hastened to like it. Hayden is an

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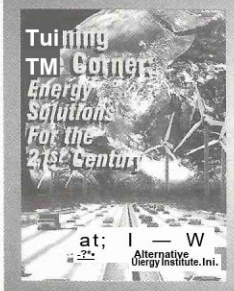
enthusiastic supporter of this *dictat,* and who am I to Grinch his Christmas? It really is a good idea to quantify all forms of energy in the same units. . .and watts per square meter are as good as any. If the book did nothing else, it would be valuable for this contribution. Now we can see photovoltaic watts arrayed against wind-power watts, against nuclear-power watts, against hydro-power watts, *etc.* When these various watts come out of your electrical socket they operate your hairdryer just the same, so why not measure them all in the same unit? Well, it's not quite that simple, there's thermal watts and there's electrical watts (and then there's watts known to the State of California), but. . .shucks, let's not be picky.

Although principal attention is paid to the Don Quixote, or windmill, embodiment of the solar energy fraud, the others such as the photovoltaic energy fraud are not neglected. In this connection I have to tell a story: When I lived some years ago in McLean, Virginia (a bedroom community of bureaucrats wealthy enough to be tree-lovers) the solar cell mania struck and a house was built across the street with photovoltaic cells on its roof. The house was situated far down a sharp slope below the road, in a hollow surrounded by old-growth trees. A more dank, sunless enclave could not have been found within a day's march by the Army of Northern Virginia. But up on the slope above this stood another neighbor's house also with trees around it. The newcomer, on moving in, promptly proceeded to lobby to have that neighbor's trees cut down. I hope all you well-to-do, right-thinking, arbophilic Greens are keeping score here. Let's face it: Even the most well-intentioned gut is an organ ill-adapted to dealing with energy problems on a supra-metabolic level. . .the brain is a much more suitable choice.

I strongly recommend this book as a starting point for the reader's own assessment of energy problems. It will provide him (or her, to be politically correct, or it, to be logically complete) with the factual raw materials to motivate the search for new energy sources more trustworthy than myths about the Sun as savior. It will also provide its readers with a useful appraisal of those tighteners of other peoples' belts who preach energy conservation as the solution. (I am reminded of Charlie Chaplin's memorable first speech in his film "The Great Dictator," when in the course of burlesquing a Hitler tirade he screamed, "Wir muessen tighten die belten und strafen diejueden. . 1") Innovative approaches to new energy sources, such as interest most of the readers of this publication, are not the subject of this book. Nor is the book concerned with selling some pre-packaged "answer" to the energy problem. It is focused accurately on refuting irresponsible solar energy claims that have gone for years without effective challenge, and indeed have been widely promoted by the media. Its author welcomes any and all informed attempts to deal with the pressing energy problems generated by an ever-growing world population. But he is right, that first the decks must be cleared of patent-medicine solutions, pushed by scientists of the stature of Jane Fonda. Those who would send their boy, the Sun, to do a man's job have met their match in Howard Hayden. Three cheers! Let's hear it for the facts—palatable or not. By writing this book and by publishing his uncompromising monthly newsletter, *The Energy Advocate,* Hayden has shown his fellow scientists what it means to be both a scientist and a concerned citizen of a country sorely beset by a plague of media-boosted fraudulent know-it-alls.



Turning the Corner: Energy Solutions for the 21st Century

by Dohn Riley and Mark McLaughlin
ISBN 0-9673118-2-9
$24.95 Paperback, 385 pp.
Alternative Energy Institute, 2001

Review by Eugene F. Mallove

"THIS is a refreshing, very useful compilation of both new energy technologies (such as cold fusion and "ZPE" energy, which work on new physics principles) and "conventional" renewable energy sources, such as solar power, wind power, and biomass. The self-promotion on the book jacket is accurate: ". . .entices the imagination with a thorough analysis of current energy use and an overview of the many potential breakthrough technologies being pursued by free-thinking inventors, engineers, and physicists. This Internet-linked book provides accurate, understandable, and compelling information about nonrenewable energy use, the potential for renewable wind and solar power, and the latest in energy and propulsion research and development."

Of great utility is that updates of the book, perhaps some gleaned from frontier information found in articles in *Infinite Energy,* will appear on the Alternative Energy Institute's website: www.altenergy.org/solutions. There are copious footnotes with references to many other critical websites. This well-illustrated book is very accessible to the general reader, so it should draw in a broad spectrum of readers. Many in the evolving force of new energy pioneers and supporters may then choose to focus their attention on one or more aspects of the new/alternative energy revolution.

The pattern of the book is straightforward. Section One: Define the world energy problem as it exists today. Section Two: Explore conventional renewables. Section Three: Explore new energy (and propulsion) research being examined by researchers worldwide. Section Four: Describe a possible transition scenario to a clean and abundant energy world that is no longer dependent on hydrocarbon fuel and fission nuclear power.

The very good twenty-page section on cold fusion ends with this sage advice to the cold fusion community: "A working cold fusion cell would instantly attract millions of dollars toward additional funding if presented properly. Technical progress and good experiments alone will not convince the public, and public support for cold fusion is essential to its success." The "Zero-Point Energy" section, by contrast, is less satisfactory, but still a good introduction for the general reader. Aether energy, space energy, and "ZPE" activities are moving so fast at the moment, it is understandable that the authors found this area difficult to encompass. For one, it is a field that is less integrated in its outlook than cold fusion. ♦♦♦

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Materials Properties of water Related to Electrical and Gravitational interactions

G.C. Vezzoli*

Abstract

Herein changes in the materials properties of water are shown that are caused by subtle energy effects connected with electrical and gravitational interactions. The effects of anomalies in conditions to which water is subjected, we suggest, may lead to significant biological alterations.

Introduction

In recent times, the study of water has emerged as an area of significant research. Although it is universally believed that water as a solvent is among the most important of all materials, these studies have revealed gaps in the scientific understanding of the structure and behavior of water. The properties of materials with water of hydration, the analysis of aqueous solutions, and the study of biomaterials all require an understanding of the materials properties of liquid water. We have experimentally examined some of these properties as a function of subtle energy changes due to electrical and gravitational effects.

Relation to Previous Work

In a series of papers we have shown that materials in the liquid state undergo distinct changes in short-range order and in properties caused by changes in temperature and pressure, and are characterized by regions of stability of specific allotropes in the pressure-temperature projection of the Gibbs surface.[1] These effects are related to the bond lengths, bond angles, and local symmetry of the liquid species, and indicate that liquids are better represented by a microcrystalline rather than a random network model.[1] The water that exists inside living cell cytoplasm changes between phases of disordered liquid and ordered gelatinous solid, the fluctuation between the two phases determined by the polymerization of the actin cytoskeleton.[2] This biological phase transition behavior in a system of water molecules in a microtubule may link to a quantum coherency (or a superposition of many possible states) that could explain the unity of biological functions in a living cell and could relate to consciousness in higher organisms (see Figure 2, Reference 2). Water in a microtubule environment must also admit to gravitational effects. In that water is inside and around DNA/protein molecules,[3] the gravitational effects then can become a very important consideration relative to diffusion and life sciences. In addition to *direct* hydrogen bonds between protein and DNA, there are water bridges that exist in a large number of complexes. The effect of hydrogen bonds in these water molecules has been predicted by Monte Carlo methods using such systems materials in contact with DNA as a protein subdomain of length 63 amino acid residues bound to a DNA fragment of 19 base pairs length with 57 water molecules.[4] It has been shown[5] that increasing the temperature of water causes (in hydrated gypsum) an increase in the hydrogen-hydrogen bond length, which then consequently causes an increase in the bond angle to a value above 104° 27' (dependent upon even very small changes in temperature). The work[5] also reports the effects of varying pressure. Any induced change in bond length can have serious effects on the sheathing properties of water and influence on adjacent chain molecules.

In this work, we report the response of the water molecule to gravitational, electrical, and photonic effects. The bond strength, polar character, bond length, and bond angle of water at room conditions are very well-documented. One of our interests is to study whether in free fall there is a tendency for H_ZO nanoclusters to align the oxygen side (negatively charged region) vertex angle with the vertical gravity vector (and create nesting akin to local regions of an A7—cormgated—structure). This might be expected from a micro-hydrodynamic and even an electrostatic argument, especially considering the presence of the lone pairs on the oxygen, and in that water molecules are mobile and only linked toward each other by hydrogen bonds. Levengood and Gedye have reported[6,7] that experiments using a capacitive charge density pulse technique have shown differences in current (in the microampere range) between vertical and horizontal orientations of a water-filled (312 ml) plastic tube with opaque plastic ends and two 8-turn helical aluminum wire electrodes, and in the vertical mode differences relative to whether the base electrode was the anode or cathode. The pulse value magnitudes were always recorded to be *least* for the horizontal orientation and *most* for the base-anode vertical orientation. The inferences from this work suggest that an electrogravitic effect may be present such that when the base is positive, the effect is maximized, because the molecule clusters may align their polarization vector with gravity, the negative region being lowered relative to mechanical ground potential and being involved in a coulombic interaction with the base electrode. This work motivated us to study the deflection of water in free fall as a function of external static charge to determine whether the positive hydrogen side or the negative lone-pair oxygen side of the molecule is more influential relative to static electrical effects.

Experimental Results

A) *Interaction with light experiment, showing laser-induced perturbation of water relative to gravity.*

A balance beam is precisely balanced at equilibrium with a 10 gram standard brass mass placed 8.0 mm from the left extremity to act as a baffle for a *single* droplet of water, and a balancing 20 gram standard brass mass at the appropriate moment arm to the right of the fulcrum. A laser beam (100 mw cw He-Ne) is directed perpendicular to the motion of the plane of the balance beam and incident upon a light detect-

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ing diode (the output of which is fed into a Goerz chart recorder), but partly blocked by the top right extremity of the balance beam (striking the beam at a grazing position).

One droplet of water is released from a burette directly onto the left extremity of the balance beam, which by surface tension is trapped between the baffle and the edge of the beam. This droplet then causes the disturbance of the balance of the beam and deflects downward the left-hand side of the beam. The consequent upward deflection of the right side of the balance beam then blocks the laser beam or partially so. When the kinetic energy of the balance beam, due to the perturbation caused by the impact of the droplet, is expended, the unbalanced potential energy causes oscillation. After a few oscillations to establish a wave pattern on the chart recorder, a second laser (200 mw cw He-Ne) is energized and directly incident upon the droplet of water. The result of the incidence of the second laser is a clear change in the wave form recorded by the chart recorder on the Y vs. t mode. This effect occurs no matter where in the phase of the motion of the balance beam the second laser is energized. (The light-detecting diode is totally baffled from the radiation of the second laser.)

An altered procedure is also employed in which the beam is balanced by the 20 gram counter weight *after* the water droplet is delivered, and then the second laser is energized incident to the droplet. The result is an imbalance of the beam with only barely measurable oscillation.

The data and configuration for the above experiment are given in Figure 1. In the first and fourth traces of the figure, the numerically integrated averaged area under the wave form is essentially identical before and after the incidence of the second laser, although the waveform changes. In trace five the procedure was varied, as described above. In the third trace and in the lowest trace, the system shows significant attenuation, however, again the character of the waveform clearly changes after the incidence of the second laser on the water droplet. The implication is that scattered and absorbed radiation can affect gravitational interactions, and can subtly affect sheathing, occluded, or diffusing water molecules. Thus the materials properties of water are subject to radiatively-induced gravitational alterations.

B) Van de Graaf generator experiments.

In Figure 2a, data are given showing the increasing deflection angle of an otherwise free-falling thin "pencil" of water (from a standard burette, mounted 30 inches above ground potential) as a function of the percentage of total power input to the belt of a Van de Graaf generator. Since the dome of the generator becomes more positive as the belt speed increases, it is clear that the negative region of the water molecules have more spatial influence than the positively polarized regions, this probably due to charge density considerations and the presence of the lone pairs. The deflection of the water follows a curved path because of the combined dependence of both gravitational and coulumbic interactions. The average deflection angle versus power input to the Van de Graaf belt (charging of dome) shows a composite essentially linear dependence. In using a 50% saturated $NaCl\text{-}H_2O$ solution, the deflection angles varied through a much smaller angular range, however in employing a weak 25% solution the deflection was almost as pronounced as for 0% NaCl. This suggests that the higher *charge density* of Na^{+1} relative to Cl'^{1} is more effective in counteracting the positive dome's attraction for the negative side of the water molecule, but even at 50% solution the negative region of the water molecules prevails in influence. The deflection angle of the otherwise free-falling water stream was also measured as a function of charging time from 10 to 40 sec, and showed linear dependence (Figure 2b).

C) Laser transmission experiment as function of free-fall distance.

In this experiment a single droplet of water (colored green) was allowed to free-fall through a variable distance prior to incidence with an orthogonal He-Ne laster beam (200 mW). The transmitted intensity was incident upon a light-detecting diode, the output of which was fed into a Goerz chart

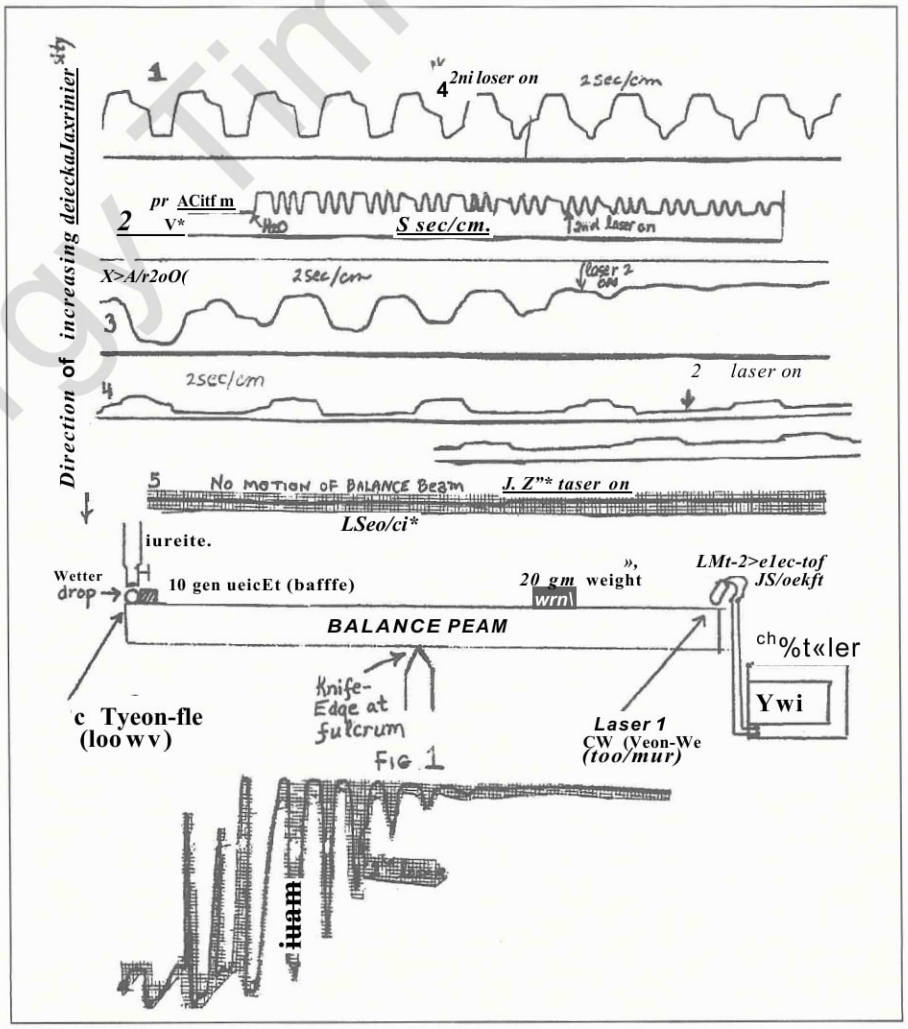

Figure 1. Data and apparatus for laser coupling balance beam disequilibrium.

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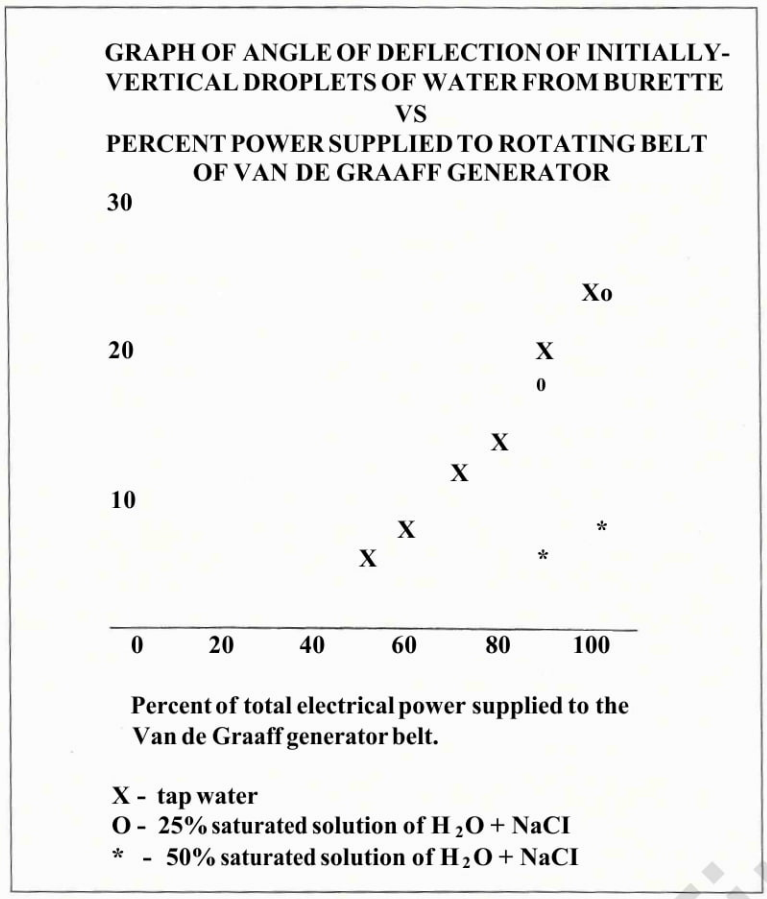

Figure 2a. Graph of deflection of otherwise free-falling water versus percent power to the belt drive of a Van de Graaff generator showing effect of positively charged dome on negative region of the water molecule, including data for 25% and 50% NaCl solutions.

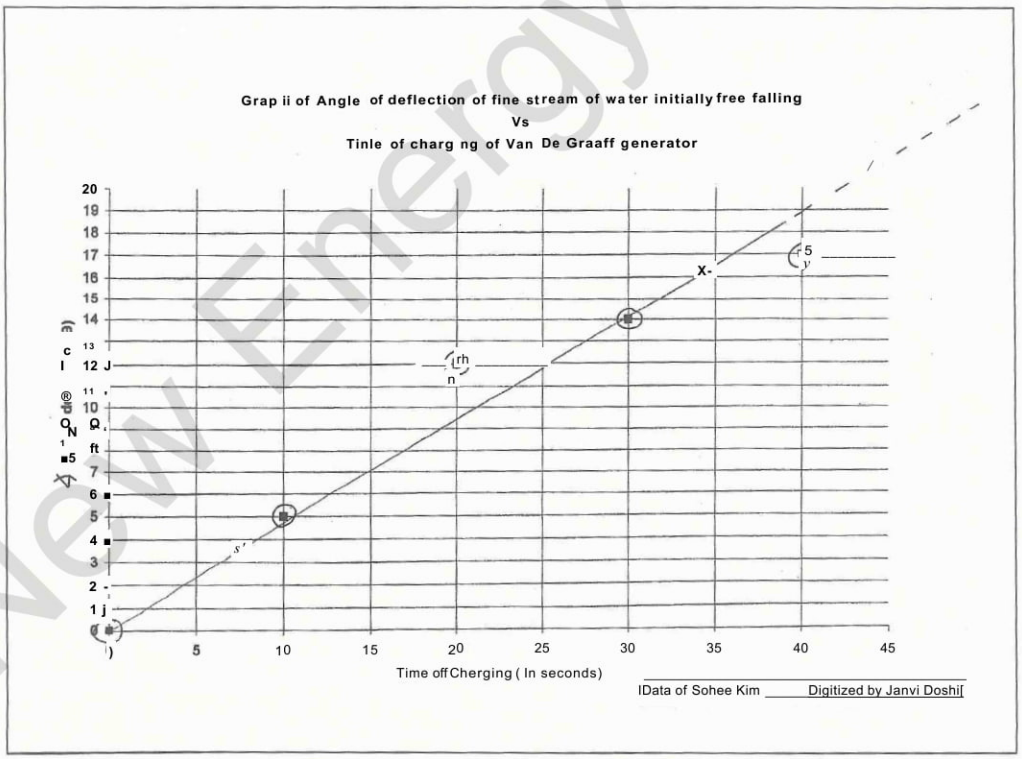

Figure 2b. Graph of deflection angle versus time of charging of dome.

recorder without further amplification or processing of the signal. The droplet having the longest free-fall path (14.7 cm) though having the highest velocity, and seemingly expected to be associated with the shortest laser interruption pulse width, is actually associated with the *longest* pulse width because of the elongation of the droplet due to gravity acting on a liquid of a high surface tension, and due to aerodynamic drag considerations with the atmosphere. This droplet elongation is believed to be an indication of geotropism partly due to the orientation effect on the H_2O molecules. It is notable that the intermediate free fall data points of 5 cm and 11.2 cm show somewhat truncated or flattened wave forms. We postulate that this is due to the orientation-influence and randomizing effects are balancing each other, whereas in the shorter time of fall the peaked non-differentiable signal suggests that orientation has not yet become significant. The above data suggesting that water orients itself with gravity may assist in explaining why water molecules are so mobile and do not become trapped en route through the process of hydrating of organisms.

Figure 3a (inset) gives our data on the increasing weight measurement as cubes of ice melt—due to the increased probability of elastically and/or inelastically scattering gravitons by nucleons in the liquid (disordered) state. Therefore the liquid form, having perceptibly higher weight, will respond to gravity with a higher magnitude interaction, and the flow will be largely geotropic. These measurements are in consonance with our published model for the mechanism of gravity being due to momenta transfer from external omnidirectional particles,[8] thereby involving a probability for elastic and inelastic scattering which will be affected by order-disorder, rather than from any internal pull.

D) Orthogonal laser incidence upon suspended droplet of water.

The 200 mW Neon laser is directly incident upon the lower extremity of a droplet of water suspended from a burette by the H_2O surface tension at a distance of 24 cm. The transmitted beam is then incident upon the light-detecting diode whose output is fed into a Goerz chart recorder operating at 1 sec per cm in the Y vs. t mode. The output wave form of the light-detecting diode is approximately sinusoidal with a period of 10-20 sec depending upon the position of incidence of the laser upon the droplet. (See Figure 3b, first part of top trace; the data were consistently taken at latitude 42N degrees, longitude 75W degrees in June during morning). It appears that

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the hydrogen bonding of the water nanoclusters acts analogous to a Hooke's law restoring force in interplay with the microchanging gravity vector (depending upon the gravitational interactions in the z direction). The second laser (He-Ne 100 mW cw) is then energized, striking the droplet orthogonally to the first laser beam, resulting in a decrease in the period of the wave form of the light-detecting diode output given in the latter part of the trace of Figure 3a, showing a period of about 5 sec which remains after the second laser is turned off. The data suggests that the gravitational properties of water are sensitive to perturbation by orthogonal beams of protons and that this may relate to the polar properties of water.

The model which we have proposed for the mechanism of induced gravity due to external omnidirectional particle net momenta transfer,[8] combined with considerations of the surface tension of water, suggests that at mismatches of the index of refraction at an interface, laser scattering versus time should show a distinct difference depending upon whether a column of the denser water was atop (overlying) the boundary versus whether air were the overlying column. The model also would predict that at least a difference would be observed based on whether the columns, and their interfaces, were in a vertical or tilted attitude, since the cross-sections for graviton capture would be different. This is borne out experimentally in the data of Figure 3b, in which the laser transmitted intensity clearly increases as a function of time for the overlying water in vertical attitude, but hardly changes for the overlying air in tilted attitude (see diagram of glass-tube container geometry). These results were cross-tested by use of a de electrical resistance measurement such that the negative electrode was in the configuration of a 20 cm suspended spring (coil diameter 2 cm), and the potential-difference (voltage drop) across water (contained in an open-top plastic cylinder) was recorder versus time, using a vertical attitude for the system versus employing a tilt of 20 degrees from the vertical. In order to promote higher sensitivity to a change in the attitude angle of the jig, we utilized a web-like appendage of copper hydroxide which was induced by higher current densities to form at the positive electrode. The fractal-type geometry of this fine (bluish) "cloud" of $Cu(OH)_2$ was very sensitive to the angle of tilt of the jig. The data are shown in Figure 3b (lower). The vertical attitude data shows considerably more fine structure statistical behavior suggesting greater influence of the spring and the "electrode," as would be expected from an attitude that would be more affected by the major component of gravitational interactions. These data lend further credence toward the inference that *materials orientations influences microgravitational interactions, which in turn influence subtle transmitted energies that can relate to bridging and/or sheathing in biological materials.* Conversely, gravitational interaction anomalies can influence bond angles and hence the probability for the formation of alternative bonding configurations can be changed relative to the energy required to overcome the activation energy as described in the Maxwell-Boltzmann statistics. This is particularly pertinent to the water in the xylem of a twisting vine, the properties of which we have studied in detail in the past year.[9]

Implications of the Water Study

The length of the hydrogen-hydrogen bond in water-of-hydration of gypsum as a function of temperature from near absolute zero to about 310°K shows a statistically varying increase from, respectively, 1.846A to 1.873A (data taken from neutron diffraction and neutron scattering).[5] This change of about 1.5% will have non-negligible influence on spatial charge density criteria that affects adjacent molecules such as dimers and polymers. Calculations indicate that even a fraction of this alteration, due to a 1-3 degree change in temperature, can have manifest influence on molecular orbital properties. The decrease in the bond angle due to increasing pressure (measured through compressibility and the bulk modulus) implies a decrease in bond angle accompanying decreased gravitational interactions such as caused by syzygy or the full moon or total solar eclipse.[8] Such an effect on water should also occur relative to (and transferred to) the bonds of DNA, especially when the spiral chains are forming, and consequently possibly cause genetic anatomical or cerebral variations. If the bond angle of water undergoes changes, then the strength of the hydrogen bond also is modified. In bond formation processes and in polymerization, a change in bond angles in small fragmented chains (especially diradically terminated, Reference 1, *J. Polym. Sci.* papers) can lead to inability to reach the activation energy for a chemical bonding that would occur under normal ambient pressure, temperature, electromagnetic, and gravity conditions. The implication of our work is that the materials properties of water are indeed very sensitive to their envi-

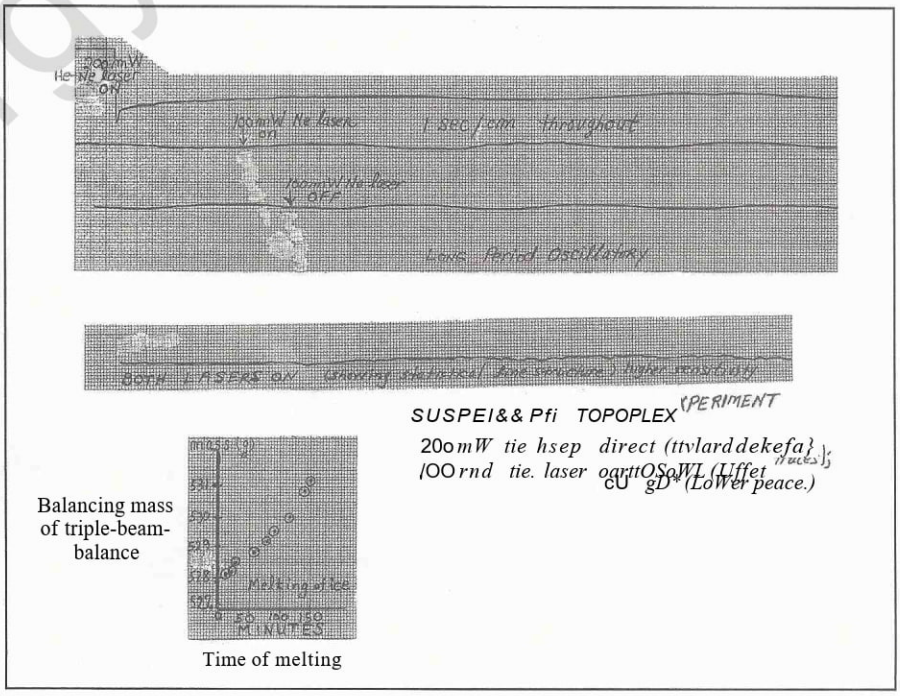

Figure 3a. Raw data for double-laser scattering from water-air vertical interface, and air-water interfaced at curved section of glass tube container.

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ronmental conditions and perturbations in overall thermodynamic environment (including gravity and electromagnetic effects), and that these variations could induce changes in DNA during the stages of early cell division after germination or conception, which could lead to disadvantageous mutations.

This is borne out in studies at the University of Texas in conjunction with NASA microgravity/plant studies on board the space shuttle, in which *ceratopteris* appears to detect and respond to gravity only as a single-celled spore, before any division takes place, and that gravity detection occurs at a very crucial time that allows gravitational interactions to influence subsequent cell polarity, cell differentiation, direction of nuclear migration, and direction of rhizoid growth.[10] Gravity-induced polarity of cytoplasmic streaming in the work of Reference 10 supports the work of Levengood and Gedye referred to earlier.[5] Further work at the University of Missouri, also in conjunction with NASA space shuttle microgravity studies, reported that in sea urchins (aragonite based) the centriole-centrosome complex during materials cell division and cilia formation shows alterations in samples that had been exposed to microgravity, while control cells that had been cultured in a centrifuge at lg in space, and those cultured on the ground, were normal.[11]

Many years of data[12] on increased birth defects in humans when conception occurred during periods of reduced gravity due to syzygy and full moon intervals supports the inference that subtle energy changes affecting the materials properties of water may be detrimental to cell development. This appears to relate to observations that electrical signals affect the materials properties of the womb to cause muscle contraction as an expectant mother approaches labor; hence these materials, with the concentrations of water content, could be vulnerable to extraneous signals of cosmogonic origin.[13]

Acknowledgements

The author wishes to acknowledge the laboratory assistance of A. Nercessian, Carolyn Ryan, M. Sullivan, D. Buckley, Elissa Kangley, Sohee Kim, J. Park, Ruth Poland, Adrienne Fulmer, Ann Osborn, Janvi Doshi, and Cindy Wu. Appreciation is also extended to Professor Rustum Roy for valuable suggestions in reviewing the manuscript.

Addendum

Prior and after the writing of this paper, we experimentally tested subtle energy gravitational effects in particular life-sciences species which are known to be sensitive to water content; these included measuring the very slight decrease-then-recovery of weight of a live cordate leaf of the heavy vine Aristolochia Macrophylla during the passage of the Sun directly overhead along the support fence of the vine (see Vezzoli, associated report, Farlow Herbaria Library, Harvard University,

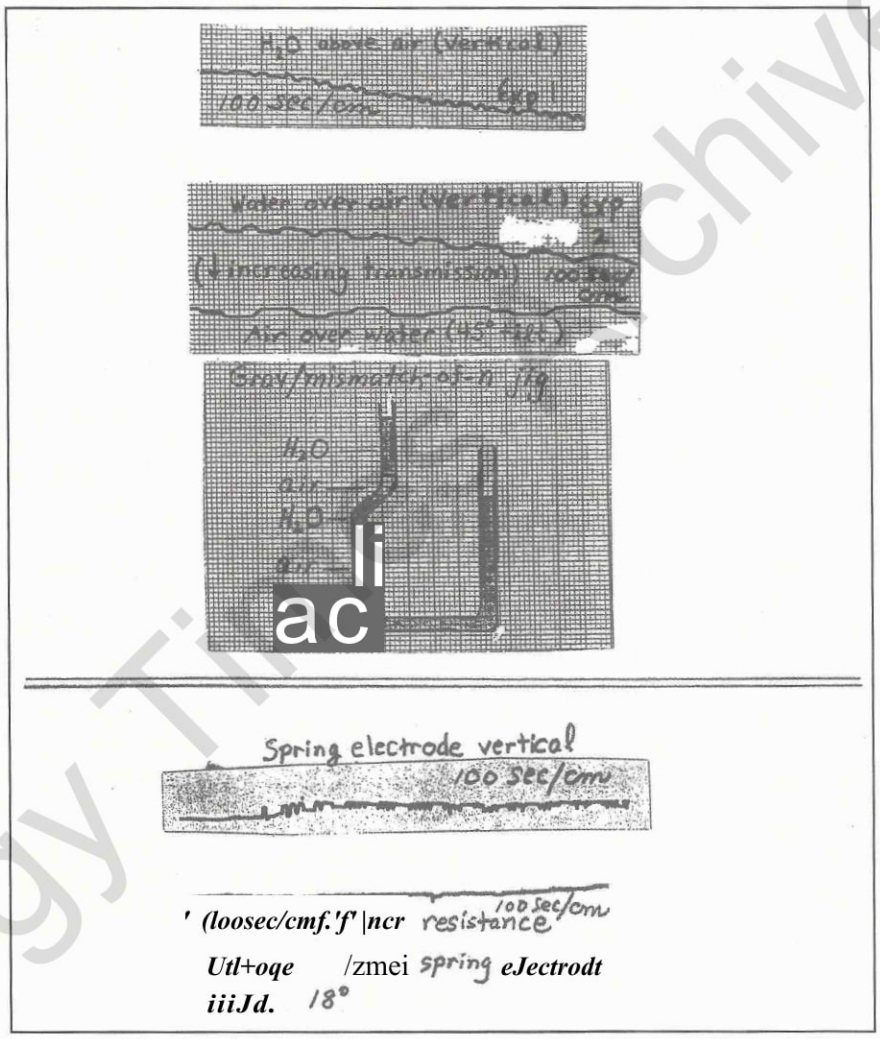

Figure 3b. Raw data for electrical resistance versus time experiment for water using spring system vertical versus tilted attitude.

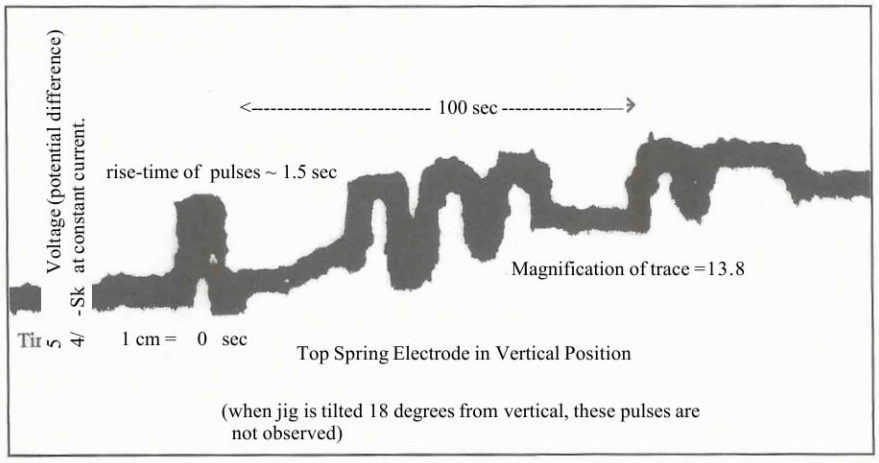

Figure 3c. Enlargement of the upper part of Figure 3b, underthe double horizontal line.

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2001); the enhanced growth rate of the extremity of a parabolic offshoot of a cactus plant during a full moon interval (slightly lowered gravity) and the retarded growth rate during the subsequent new moon interval (presented at New York Botanical Gardens Seminar, August 28, 2001); and the decrease in the closure-time of the touch-sensitive (thigmotropic) bipinnate leaves of Mimosa-pudica L. as a function of increasing the gravitational potential energy of a single droplet of water on the leaves (and related to a piezoelectric-induced initiating of a spontaneous dephosphorylation chemical reaction [see Vezzoli, associated report, Farlow Herbaria Library, Harvard University, 2002]). Our theoretical[8] study of the fundamental cause of gravity indicated that what was long considered to be a universal constant, G, is actually a function and depends upon the collision cross-section of the graviton-nucleon elastic and inelastic collision interaction. We have demonstrated experimentally evidence that suggests that G is at least a function of temperature, shape, and phase. In *Infinite Energy* #41, Harold Aspden cites references to measurements suggestive that G varies with temperature and with depth into the Earth. Shaw *(Phil. Trans. Ser. A,* 349, 1916) had reported experimentally that G increases linearly with temperature over the range of 20-215°C, according to $G(T) = G[1 + aT]$, where a - 1.2×10^{-5} per degree C. Subsequent work by Shaw and Davy *(Proc. Roy. Soc. A,* 102, 46, 1923) reported that a < or ~ $1.6 \times IO^{-6}$. Our own data indicate that a ~ $3 \times 10'^{6}$ per degree C over the reversible range of 20-99°C. Very recently Mikhail Gersteyn, Visiting Scientist at the Massachusetts Institute of Technology (UPI announcement May 2002, and private communication, *Time,* science-dialogue group) has reported that G is not a constant and varies (0.054%) depending upon orientation of the two gravitating bodies relative to a system of fixed stars. We interpret this finding to be in accord with our theory of induced gravity,[8] and the expected anisotropy of the graviton flux. These findings help explain the known increase in the H-H bond length of water[5] as a function of increasing temperature, which, as mentioned above, should be important also in water's polar influence on adjacent molecules such as DNA.

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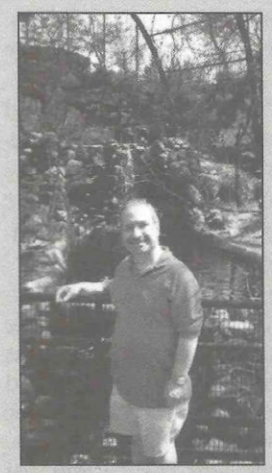
12. Gedye, J. Zygotron Corporation, Michigan; and Jones, R. Czechoslovakia Academy of Medicine.
13. We have recently completed a study of the decay of Polonium 210 (a by-product of radon decay), taking data every four hours for 35 days and observing a diurnal and monthly variation that arguably correlates with cosmophysical phenomena. Seventeen months of Po 210 decay data from a ground water study by Dr. D. Lane-Smith of Durridge Corporation in Bedford, Massachusetts, are being studied for daily and monthly variations in counts (alpha particle production). See also Shnoll, S.E. *et al.* 2000. *Uspekhi,* 43, 2, 205, on diurnal, monthly, and sidereal variation of fine structure of statistical distributions as a consequence of cosmophysical agents including the decay of Pu 239 and Fe 55 (and a series of related papers by the same first author). Also see Kozloski, J., Hamzel-Sichani, E, and Yuste, R. 2001. *Science,* 239, 868, on the position of local synaptic targets in mammalian neocortex revealing precisely organized cortical microcircuits that are weakly interconnected in probabilistic patterns, and vulnerable to be triggered by subtle energy changes.

About the Author



Dr. Gary Christopher Vezzoli received his B.S. in physics from Fordham University, M.S. in geophysics from Boston College, and Ph.D. in solid-state science from Pennsylvania State University. As a research physicist and university Professor he has authored one hundred papers published in scientific journals of physics and chemistry. Recently, Dr. Vezzoli has turned his attention to biophysics and the life sciences, from which the research that is described in this article has been derived in studies that he has conducted at the Franklin Institute and at Harvard's Farlow Herbarium. The water research in conjunction with his gravity studies has led him into current research in preventing birth defects in the very early stages of pregnancy. In 1998, while teaching physics and chemistry, Dr. Vezzoli was awarded the research project Mentor of the Year Award in the state of Massachusetts.

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- DANCES WITH PROTONS -

Ferroelectric Inscriptions in Water and Ice Are Relevant to Some Cold Fusion and Energy Systems

Mitchell R. Swartz*

Water: Central Role in Some Energy Systems Through Proton Disorder

The key to the successful design and engineering of many energy systems ultimately depends on recognizing the structure and properties of water, its proton sublattice, and its relatively unique dielectric response (reaction to the application of an electric field intensity). These systems include several of those described and reviewed in *Infinite Energy* [for example, "Speculative Interpretation of Over Unity Experiments Involving Water Electrolysis," John Bockris, *Infinite Energy,* 2, 10, 61, (1996); "Gaining Solar Energy from Ordinary Water," Peter Graneau, *Infinite Energy, 2,* 10, 59, (1996), and "Extracting Intermolecular Bond Energy from Water," Peter Graneau, *Infinite Energy,* 3, 13/14, 93, (1997)]. This paper is an introduction to these issues. Gaining comprehension of the subtle nature of water begins with a historical and physical review of its structure, with emphasis on hydrogen bonding, the hydrogen sublattice, and an introduction to proton disorder.

The Structure of Water and Ice

Water has always fascinated people, but humanity's shared understanding increased significantly after Berzelius, when in 1814 [Jahresbericht (1828)] he introduced the thereafter-very-much-used notation for water. Berzelius, as was the custom at that time, applied the proportion of each element to the symbol used for that notation. Berzelius wrote water as: 2H + O. Not much has changed except that we have rearranged this and now write H_2O.

During the following decade, van't Hoff (in Holland) and le Bel (in France) began to conceive and develop a three-dimensional structure of water molecules. Thereafter, the understanding and development of theory regarding the structure of water became associated with tetrahedral symmetry from the orientation of the oxygen atom (Figure 1).

The left side of Figure 1 shows the electron clouds of oxygen atoms in two water molecules. The bridge electric dipole arises from the superposition of other dipole moments, as discussed below, as each water molecule is hydrogen-bonded into the ice lattice. On the right side of Figure 1, five water molecules are shown interacting through hydrogen bonds. One molecule is shown at the center, and the "origin" of each molecule is taken as each molecule's oxygen atom. Each water molecule is engaged in four hydrogen bonds. In two, the hydrogen atoms are about 1 Angstrom from the origin, whereas the other two hydrogen bonds have hydrogen atoms from neighboring water molecules which are more distant. This difference is critical and creates the electric dipole moment and the proton disorder.

Water became considered as a gigantic lattice of oxygen atoms each with a pair of hydrogens. But what is the structure of water? Simply put, water is not a gas but has a three-dimensional stereo-constellation with elements of order (oxygen atoms) and disorder (protons). Water is *not* a continuum, but water's atoms of oxygen and hydrogen (or deuterons) are arranged in structures which obey definite physical rules. It is a complicated three-dimensional structure which is a lattice (the protons and/or deuterons) within a second lattice (the oxygen atoms). The fact that water has a second proton lattice within it means that water has not only singular properties, but has an incredible impact upon both the properties of materials dissolved within it (including clathrates, hydrates, biological systems, etc.) and the operation of systems using it.

Additional complexities occur because the hydrogen in water is, in part, the rarer heavy hydrogen—deuterium. However, the molecular structure of heavy water is similar to its lighter congener (and as we shall see, similar to ice). It is through studying water, and the diverse array of ices, that one can respect the complexity of water and then learn to utilize it. Water creates organization with materials through its own unique structure and properties. Dissolved materials within those organized structures further change the water and then themselves.

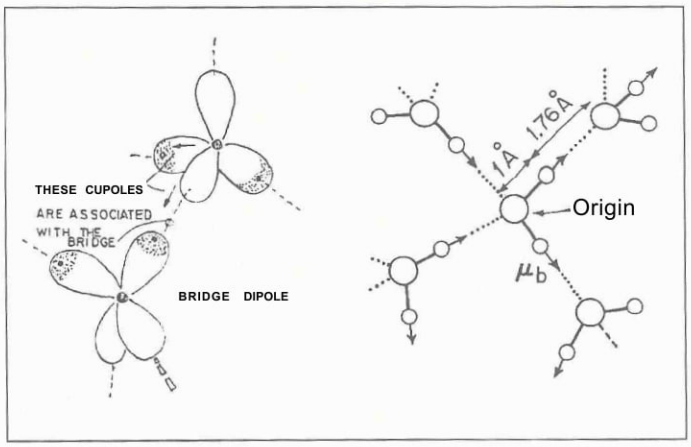

Figure 1. Condensed phases of water molecules. Left, view of the electron clouds of oxygen in two water molecules hydrogen-bonded into an ice lattice (not shown!. Right, shown are five water molecules interacting through hydrogen bonds. Each water molecule is engaged in four hydrogen bonds.

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Hydrogen Bonding and the Electric Dipole Bridge Sublattice

Much can be learned by studying the protons, their electric dipole moments, and their entropy, which results from their distribution within and decoration of the oxygen lattice. Furthermore, the most important point is that *there are two lattices* and that the proton lattices is often totally ignored.

The origin of these lattices begins with electronegativity of the oxygen atom. That electronegativity creates asymmetry by the displacement of the electron clouds toward the oxygen atom. With that resultant asymmetric redistribution of electronic charge within the water molecule, there then follows the creation of unbalanced (positive) charges at the hydrogens (or deuterons) and negative charges in the form of two "free" (negative) sp3 lobes surrounding the oxygen nucleus, which creates the tetrahedral appearance. But something wonderful happens. This asymmetric charge redistribution produces both an intramolecular dipole moment, and most importantly can result in a "hydrogen bond" [or "deuterogen bond"] by having two (or more) water molecules self-assemble. These hydrogen bonds are ubiquitous, partially due to the low steric requirements of the protons. The hydrogen bonds exist in inorganic compounds, in organic compounds, and are manifest throughout living systems, in proteins, purines and pyrimidines (DNA), and also in the ice-like hydrogen-bonded structures [anomalous, tightened-up water] which has been observed to surround DNA, hemoglobin, albumin, and collagen.

As Figure 1 shows, the H-bond process [a mechanism of self-assembly in the condensed phase] begins with the immersion of a hydrogen [actually with the asymmetric charge redistribution, this is a proton] into an electronic cloud of a second neighboring water molecule. This creates one hydrogen bond and neutralizes charge to a great degree. The coulombic neutralization yields a very large energy decrease, on the order of 4.5 kcal/mole (compared to the relatively much less "background thermal energy" which is only k_BT = ~0.6 kcal/mole). As a result of this disparity between the coulombic neutralization energy and the thermal background, the following occurs when the hydrogen bond is formed: a thermally-stable structure results with the formation of two electric dipole moments. These features enable diverse aggregate states of water/ice.

Deuteron and Proton Disorder in the Condensed Phase

> "One of his hobbies. . .photographing how cannonballs are stacked on different courthouse lawns. Apparently how they've got them stacked in that picture is very unusual."
>
> —Kurt Vonnegut, "Cat's Cradle"

Any study of water must begin through an examination of its condensed phase—ice. The phase diagram of ice is shown in Figure 2. The different types of ice, and water, are shown as a function of temperature and pressure (after the work of von Hippel, Tammann, Bridgman, Kamb, Whalley). Ordinary ice (Ice I_h) is on the very left, and lower half, of the diagram. It can be seen that ice, however, is polymorphic (has different distinct structures) and is a solid with perhaps the greatest number of phase transitions ever found. Each of these diverse and unique polymorphic solid states of water (solid ices) have been firmly established, by X-ray analysis and other spectroscopies. They are relevant because at least three types of ices are involved in everyday "ordinary water," which, as we show below, is therefore not so ordinary after all.

The way to consider water and ice is as two lattices. First there is the fixed oxygen lattice. It is ordered and is "decorated" by a second proton lattice, which is disordered in ordinary ice (IceI_h). This disorder in normal ice (Ice I_h), which is different from other phases of ice, creates a unique and remarkable proton structure. The proton structure provides a source and sink of energy and entropy that must be considered in any energy analysis. Therefore, much can be learned by studying this proton structure, the electric dipole moments (and entropy) resulting from the proton distribution, and their decoration upon the oxygen lattice. The most important points are that there are *two* lattices and that the proton sublattice is usually totally ignored.

As can be seen in Figure 1, in each of these solid phases of ice, the water molecules are linked locally by hydrogen bonds into a complicated tetrahedral system. But locoregionally, and regionally, the structures which comprise water and ice are nothing short of amazing. We first consider "ordinary" ice, which is designated as Ice I_h.

The oxygen nuclei are arranged in the well-known hexagonal lattice (Wurtzite type). These oxygen lattice hexagons are not flat, but have their puckered rings located orthogonal to what becomes an optical axis ("c-axis"). In ice samples, this optical axis (c-axis) can be observed by cross-polarizers with single ordinary ice (Ice I_h) crystals, and is shown in Figure 3 on the right hand side. There is a very important corollary which is linked to this.

Probably the most important fact in terrestrial history is that ice floats, and when it does, it protects lakes and bodies of water beneath it from totally freezing from the bottom

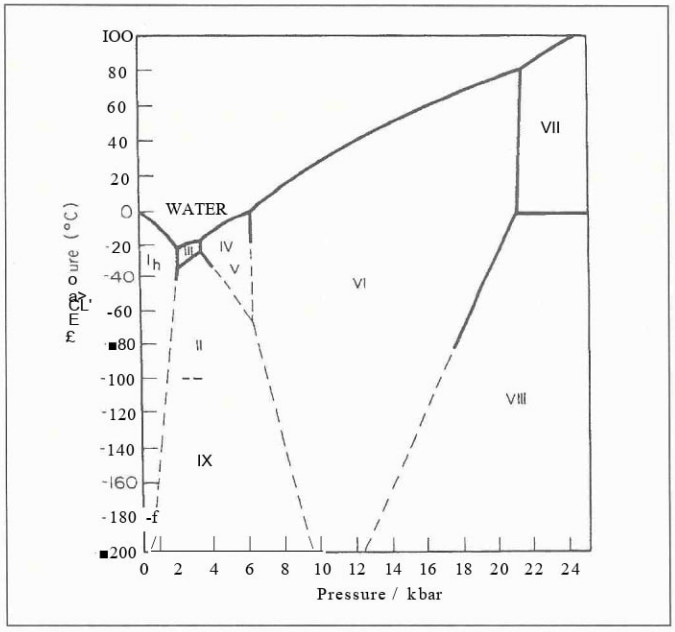

Figure 2. Phase diagram of ice. The different types of ice, and water, are shown as a function of temperature and pressure (after von Hippel, Tammann, Bridgman, Kamb, Whalley). Ordinary ice (Ice Ip is on the very left, and lower half, of the diagram.

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up. If ice did not float, then all life would have been destroyed in one cold season. It is the hexagonal stereo-constellation which is bloated, and therefore allows ice to float. The origin of the remarkable behavior is shown in Figure 3 where, for simplicity, the protons are not shown—only the oxygen lattice for clarity of understanding of the ordered oxygen lattice. Consider the hexagonal Wurtzite-like structure of the water/ice, which creates the low density of ice (-0.917 g/cc). Each oxygen (sphere) is actually surrounded with two hydrogens, with one hydrogen between each 0-0 bridge in this configuration. The channels, chair, and boat configurations are observable, in Figure 3 on the left hand side.

Proton Sublattice In Disorder

Beneath and within the oxygen lattice is the proton sublattice. The proton sublattice is derived from the tetrahedral oxygen atoms held in their stereo-constellation of the oxygen lattice. The oxygen lattice is strictly ordered, but it is important to know that by contrast the proton sublattice is disordered, locally. In the long range, the proton arrangement must be disordered because every oxygen bridge has two equivalent proton positions. The important point is that Ice 1_h consists of tetrahedral H_20 molecules arranged in a proton-disordered stereo-constellation.

The calculation of the entropy of everyday Ice 1_h's randomized proton lattice was first determined by Linus Pauling. Consider the many possible proton configurations in Ice 1_h (and contrast this later to that for Ice 2, below). There are six possible configurations of the protons which can exist for any two oxygen nuclei (Figure 4). Because these two nuclei are actually indistinguishable, there are only three such configurations. There are some additional boundary conditions, however. In Ice 1_h the layers of oxygen nuclei must alternate in their relative proton (dis)order. Thus, because each layer must eliminate the randomness from the next layers, above and below it, there are 3/2 = 1.5 arrangements. The entropy of a system is calculated as

$$S = k_B * \ln(\text{Number of states}) \qquad (1)$$

Substituting the results obtained for Ice 1_h yields $S = R * \ln(1.5) = 0.81$. This calculated value is indeed very close to the measured value of 0.82 calories/gram-mole.

Why is this so important? It was shown above that the structure of the oxygen lattice leads to the fact that ice floats. And it is clear that the high boiling point of water results from the great energy of the hydrogen bonds. (Unlike many other liquids, water remains liquid over a great range of Earth's surface temperatures.) Although these unusual characteristics have been needed for life on Earth to survive, it is water's proton sublattice and the disorder of that lattice that is key to much of chemistry, biology, and energy systems. The proton disorder of water's hydrogen sublattice leads to the unusual electric conduction and polarization properties of water. Most important, the proton disorder creates the large dielectric constant of water that enables water to dissolve so many materials. Furthermore, the proton disorder of water and ice contributes to the great heat capacity of water (the ability to absorb heat with a negligible increase in temperature).

In contrast to "garden-variety" Ice 1_h, the other ices are of academic interest. Ice 2 has proton order and can be obtained by cooling Ice 1_h to minus 50 degrees Centigrade and then squeezing it to a pressure equivalent to or exceeding 3000 atmospheres (Figure 5). The proton order of Ice 2 has been confirmed by infrared and dielectric spectroscopy and by neutron diffraction and nuclear magnetic resonance studies. Figure 5 shows the proton ordered structure of Ice 2. As expected from the proton order, the entropy of Ice 2 is lower than that of Ice 1_h (0.77 calories/gram-mole). More important, its dielectric constant is not abnormally highly elevated like it is for Ice 1_h, but is similar to other matter.

In the transition from Ice 1_h to Ice 2, half of the hexagons are destroyed along with much of the proton disorder. In the transition to Ice 3, all of the hexagons are destroyed. Ice 3 has pentagons in the oxygen lattice instead of hexagons, and in the transitions from Ice 1_h to Ice 3, every fourth water molecule is ejected.

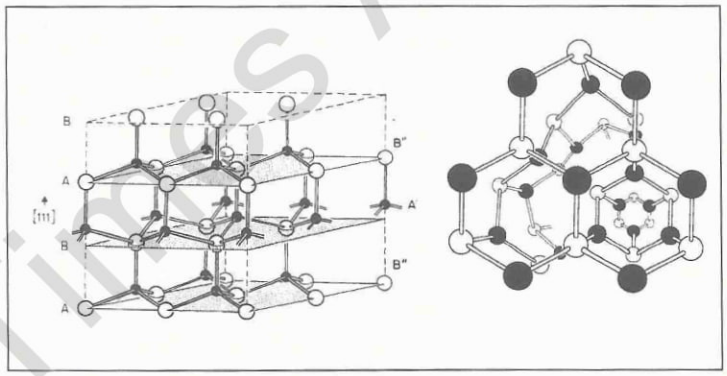

Figure 3. Ice 1 lattices of oxygen nuclei in hexagonal arrangement. Left, the Wurtzite structure of Ice 1 showing the eclipsed lattice which creates the open optical (c-axis) axis. Right, examination of the oxygen lattice in Ice 1 showing hexagonal channels when the ice is viewed along the c-axis.

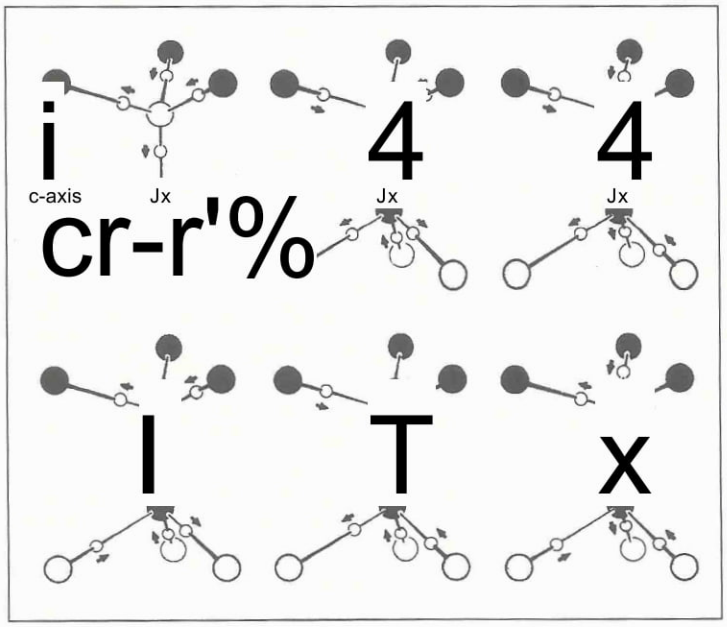

Figure 4. Possible arrangement of protons in Ice 1 Shown are the six possible arrangements of protons in a Wurtzite-like (eclipsed) Ice 1 structure composed of eight water molecules.

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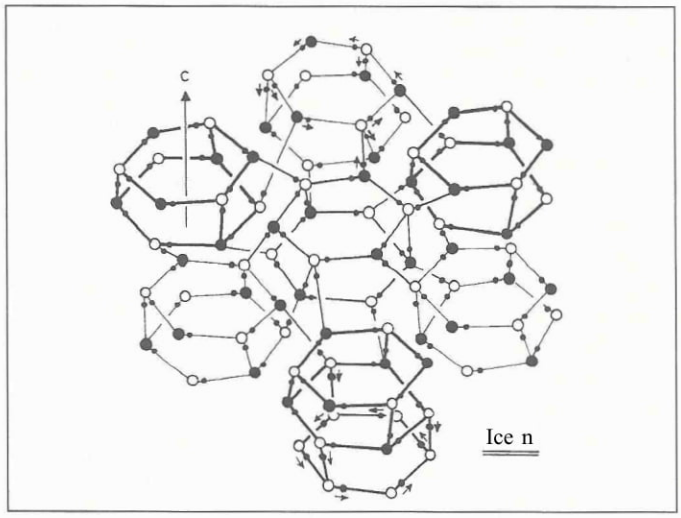

Figure 5. Ice 2 has a deformed hexagonal Wurtzite-type lattice, but consisting of tetrahedral H2O molecules held in a proton-ordered stereo-constellation form. The crystals have lost half of the hexagons and show twinning.

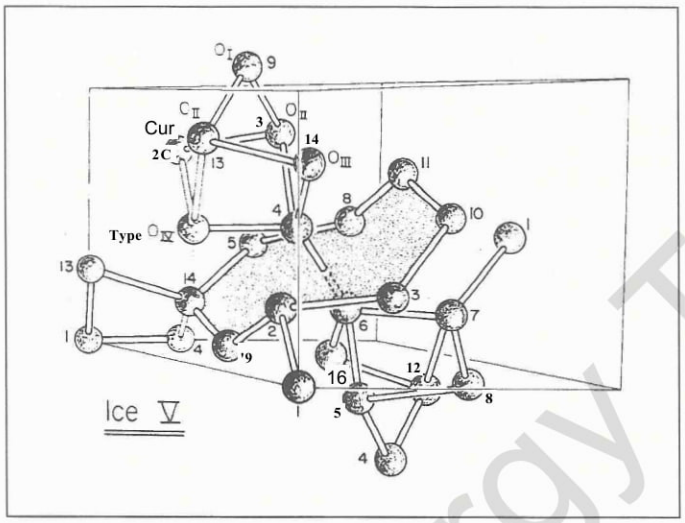

Figure 6. Ice 5. The oxygen lattice is shown. The repeat groups have seven water molecules in the unit cell.

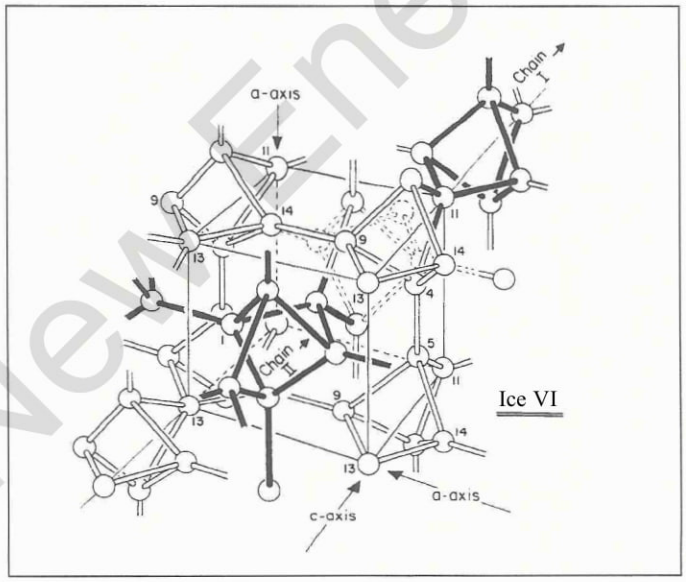

Figure 7. Ice 6. The oxygen lattice is shown. Ice 6 is a "self-clathrate."

Ice 5 contains repeat groups of a peculiar oxygen lattice consisting of seven oxygen atoms forming two 4-rings and three 5-rings (Figure 6). These formations occur four times in each unit cell of the lattice. The proton organization shows statistical disorder, and the positions of the water molecules are simply not of equal probability.

But it is not the bizarre structure, nor the intermediate proton order, that makes Ice 5 so interesting. It is the story of "Cat's Cradle" by Kurt Vonnegut in which he describes an "Ice 9," a fantasy form of ice, which continues to grow its phase, as it "militantly" takes over and freezes neighboring water (and people). Interestingly, he anticipated the phenomenon of *prions,* but as far as water goes, Ice 5 is close as it comes to water being that way. Ice 5 is very difficult, if not nearly impossible, for most laboratories to make directly from water. However, once Ice 5 does form in an apparatus or cell, subsequent attempts to make Ice 5 suddenly become much, much easier to do! The result is that it appears that Ice 5 "seeds" its own formation once it is present in the apparatus. It does not fully "melt" or disappear, but when a surface is provided, some of it survives.

The last of the phase of water/ice to be discussed in this very brief survey is Ice 6, which is a self-clathrate when considered from the view of the oxygen lattice (Figure 7). The structure of Ice 6 is reminiscent of fibrous zeolites used for many ion exchange experiments. There is no doubt that the polymorphs of water/ice are diverse, profound, and scratch the surface of complexity, because beneath each is the proton sublattice.

The Structure of Water

So what is the structure of water? The structure of water is very close to that for ice, the single crystals as discussed above. The structures of the ices have been revealed by X-ray and neutron spectroscopic data, which have revealed a wealth of knowledge of the water-ices, some of which is discussed above. The structure of water is a composite of water-ice's unusual and distinctive structures, and the knowledge of the ices has been used to deconvolve the radial distribution functions obtained using diffraction data of water. These results indicate that water is similar to a specific combination of some of the ices. Based upon the studies of the ices, water appears to be a mixture of Ice 1_h (50%), Ice 2 (30%), and Ice 3 (15%). Probably much more subtle variation exists, and certainly so near any electrode, double layer, and/or energy system.

To those that ignore the X-ray spectrographic data and continue to argue that water is more like a gas than ice or who ignore the proton disorder, consider the following: The X-ray diffraction data of the ices has been successful in explaining their behavior. Furthermore, only about one-seventh to one-quarter of the hydrogen bonds in water are broken compared to fully frozen ice. This can be quickly shown as follows. Consider the ratio of the heat of fusion (which is what takes ice to water) to the heat of vaporization and fusion and two other terms. The first additional term in the denominator is the 100 calories required to reach 100 Centigrade. The second term arises from the fact that ice is not truly a solid (consider the surface during skating) until -30 Centigrade, which adds yet another 0.5 cal per gram-degree of the material to the denominator. This ratio supports the details and conclusions outlined above, that the only correct conclusion is that the majority of

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hydrogen bonds in water are intact. Water is very much like Ice 1_h, Ice 2, and Ice 3, and in that order.

Background: Conduction and Polarization Are Related

All materials are characterized by their response to an applied electromagnetic field. At low frequencies, the magnetic field can be neglected and what is important is the response of material to an applied electric field intensity. The applied electric field intensity, E, results in an electrical conduction within the material, and via the electrical conduction process (and there may be many) there follows polarization. Depending on the materials, solutions, and electrodes, if irregularities are present at an electrode, for example spikes on a cathode, then the electric field intensity distribution can change dramatically with tens of thousand of volts per centimeter appearing over, or near, such irregularities.

Electrical conduction and polarization are, and must be, related because any motion of charged particles, and of molecules with distributions of charge, result in necessarily both conduction and subsequent polarization as a result of the motion. Thus, these two aspects of the complex permittivity are related through Hilbert Space. It is this polarization—ionic polarization, atomic polarization, orientation polarization, space polarization, and domain polarization—that makes each material unique.

From a mathematical point of view, the polarization [id] is the real part of the complex permittivity [K*], and specifically is what is called the "dielectric constant."

$$K^* = K' - j K'' \qquad (2)$$

Kgis the permittivity of a vacuum and K is the relative permittivity (so-called dielectric constant, which is actually a function of frequency).

The electrical conductivity of a material is mathematically described by the imaginary part of the complex permittivity.

$$K'' = o * co \qquad (3)$$

For most materials only electronic and ionic polarization dominates, and hence the dielectric constants of almost all materials are usually in the range of 3 to 6. However, for water, or Ice 1_h, because the arrangement of the molecules and the proton disorder in the sublattice introduces new possibilities of electric conduction and polarization (Figures 8, 9), the dielectric constant is a whopping 92 for ice, and 88 for water.

The large dielectric constant (= the real part of the complex permittivity) is important because this feature enables diverse reactions ranging from chemical solvation to free radical reactions, which can then occur by shielding of the resultant free charges. It is not a constant, however, but changes with frequency and is measured by dielectric and transconduction spectroscopies.

Dielectric Spectroscopy of Water/Ice

The unusually large dielectric constant of water distinguishes it from most other materials, and enables it to be an exceptional solvent. It is water/ice's proton disorder and the drift of defects which decrease that disorder, which create the unusual dielectric properties of water. The origin of this unique feature of water/ice arises from the electrical response of water to an applied electric field intensity. When water is examined by AC electric fields, from approximately 8 x 10^{-3} to 10^5 Hertz, there can be resolved several complex dielectric relaxation spectra (for example, confer Figure 10) resulting from the proton sublattice and the movements of defects. Even the "purest" Ice 1_h has at least seven (7) discrete subspectra (not resolved in Figure 10). Most of these subspectra arise from minor imperfections in the lattice, and from multicrystallinity, and from impurities contained within the ice. Complexities to this simple picture occur from energetically cheaper sources of the L, D defects, and from proton polarons which can form around any defects, possibly trapping them and inhibiting their propagation. Thus the minor subspectra appear in "pure" ice.

The largest ("major") subspectrum (formally called #3) of water and ice is most related to the classic "dielectric constant." It does *not* result from water molecules spinning like tops. It does not result from rotation of the water molecules. In fact, it could not, because the ratio of the hydrogen bond energy to the thermal energy is so large that the bonds are stable. The structure of ice is too energetically expensive to disturb (13.5 kcal/mole for any intramolecular proton transfer and 18 kcal/mole to rip a water molecule out of an intact lattice). Hence the high boiling point of water. By contrast, the high dielectric constant of water actually results from movements in the proton sublattice, from the electric field-directed movement of defects in the proton sublattice.

Diffusion of L and D Defects Creates Transitory, Inscribed Ferroelectric Moments

L and D defects initially arise from infrared vibrations, as suggested by Bjerrum (Figure 8). Normally there is one proton between each pair of oxygen nuclei (Figure 1). A D-defect has two protons between any two oxygen nuclei. An L-defect has none. With the background thermal energy thus creating L and D defects throughout the volume of water or ice, the action of an applied electric field intensity to a sample of water/ice results in a drift of these intramolecular proton (and deuteron) defects within the proton sublattice. The movements inscribe—into that proton sublattice—a generally field-directed electric dipole moment, as von Hippel has shown.

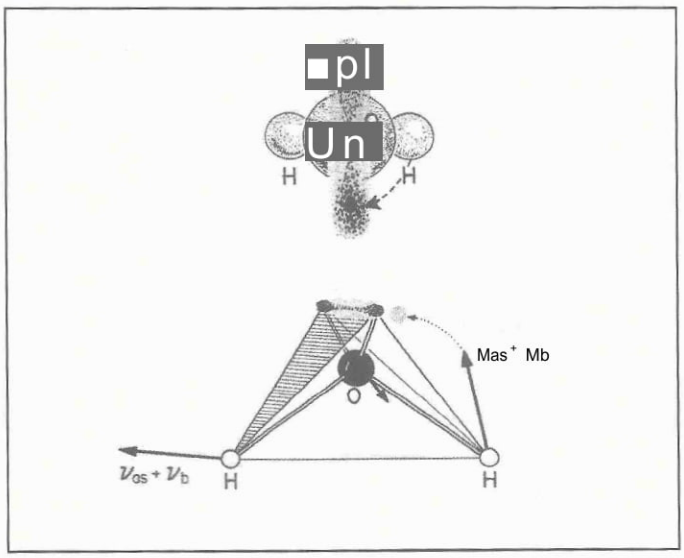

Figure 8. L and D defects. Bjerrum postulated that L and D defects initially arise from infrared vibrations. Here such vibrations launch a proton from one oxygen electron orbital to another.

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The result of an applied electric field is that it inscribes a series of intramolecular detects within the water lattice (Figure 9). The inscribed defects create a large electric dipole moment. Drift ellipsoids of the defects inscribe a ferroelectric imprint into the water; they inscribe a domain until thermal processes eventually erase it. This ferroelectric inscription has several important implications. First, it is this electric dipole moment which creates the large dielectric constant. When water is polarized there is a measured, very large dielectric constant (—95) which is not necessarily a value applicable on a molecular level, for reasons discussed above. Second, the applied electric field intensity thus offers two methods of proton transfer to the cathode. There is the conventional drift of the ions and there is possible propagation of the L- and D-defects. Those who work with cold fusion and energy systems involving water ought to consider them as well, because they impact the proton disorder itself of water and ice.

Acknowledgement

The author acknowledges and is grateful to MIT Professor Emeritus Arthur von Hippel, William Westphal, John Mara, and the other researchers from MIT's Laboratory of Insulation Research, with whom he had the honor to work from 1968 through 1971 on dielectric and transconduction investigations of "pure" ice, for their contributions and teachings. The

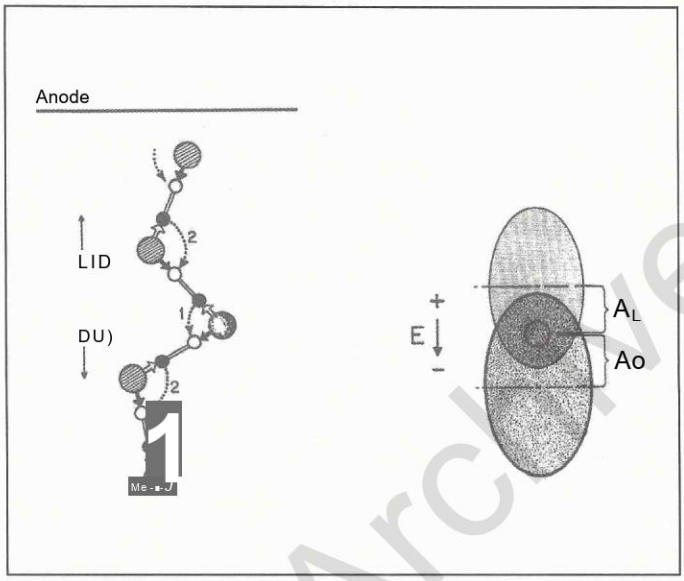

Figure 9. The diffusion of L, D defects inscribes ferroelectric dipole moments. Left, Bjerrum defects migrate and inscribe a ferroelectric dipole moment into the lattice in the von Hippel-developed model. Right lower, the defects migrate in an applied electric field intensity. The normal spheroids of defects distort into field-directed ellipsoids, which are shown. As the defects migrate, they leave trails of proton order.

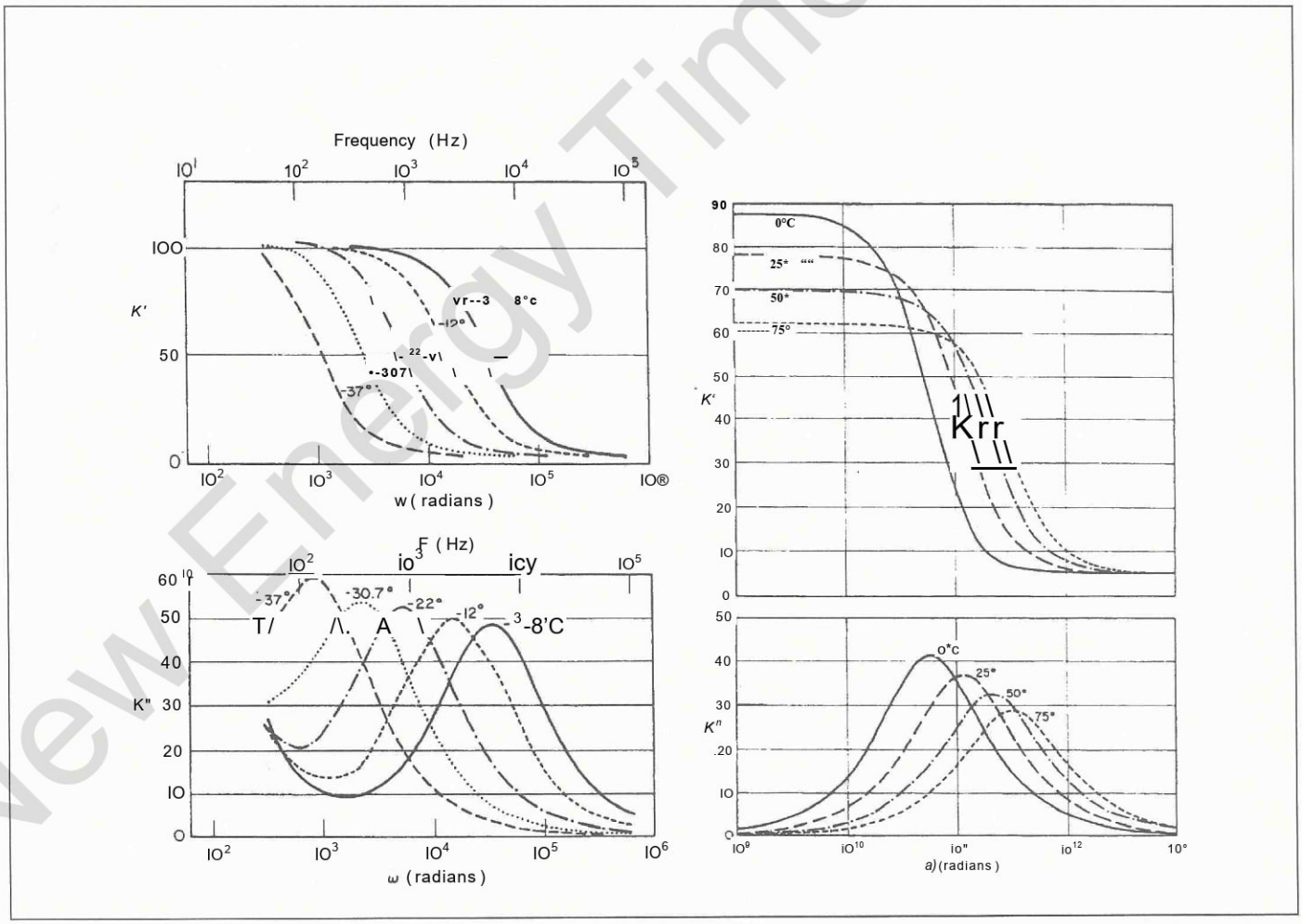

Figure 10. The dielectric relaxation spectra of Ice 1_h and water. Shown are the real and imaginary parts of the complex dielectric permittivity of ordinary ice and water. Left: the dielectric relaxation spectra of Ice 1_h; Right: the dielectric relaxation spectra of water.

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great skill of John Mara created most of the figures shown here for the Laboratory. Permission has been obtained from MIT through Prof. Louis Smullin to allow the publication of the figures here. The author is most grateful to Gayle Verner for her meticulous help with this manuscript.

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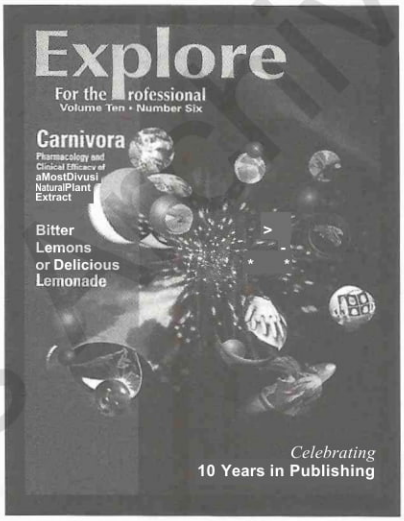

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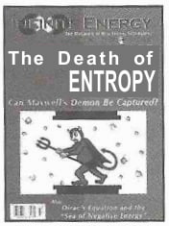

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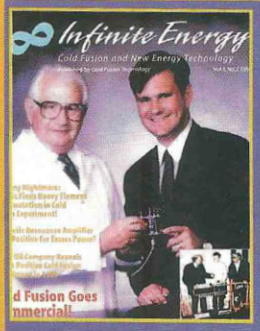

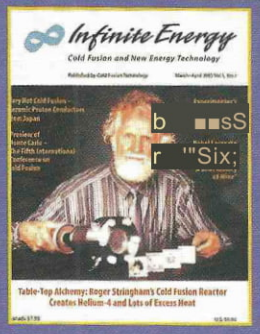

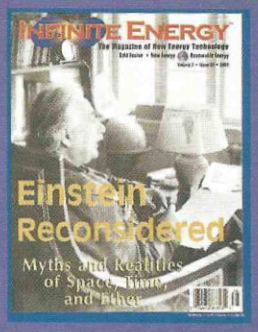

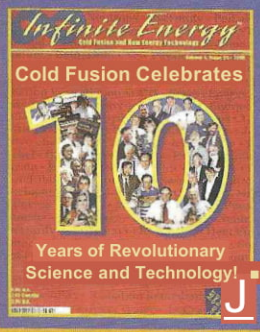

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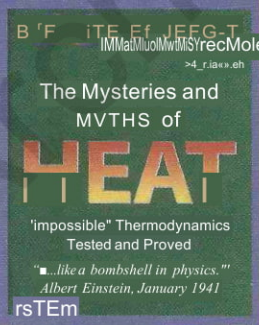

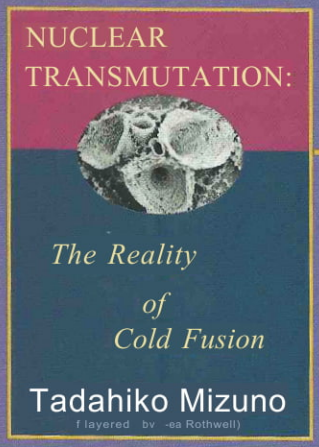

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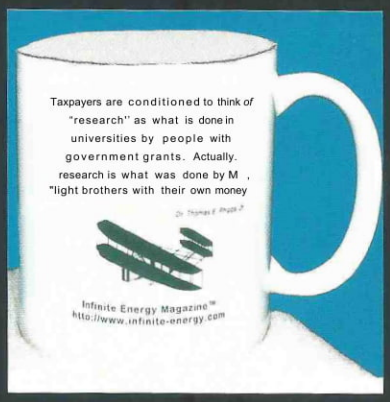

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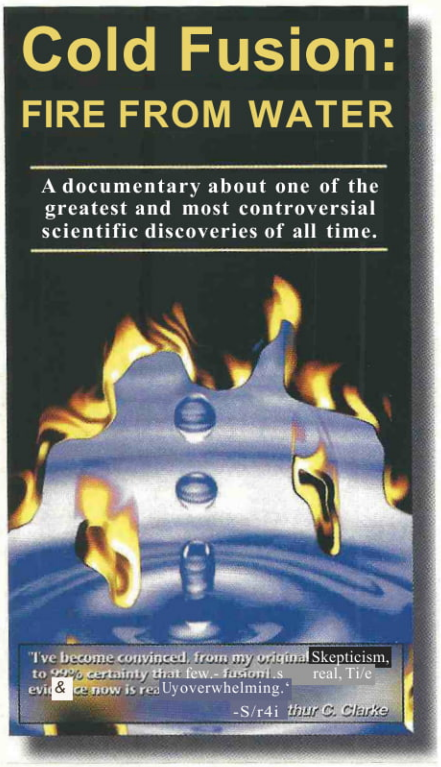

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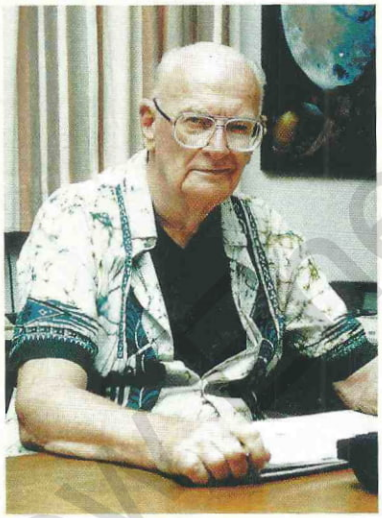

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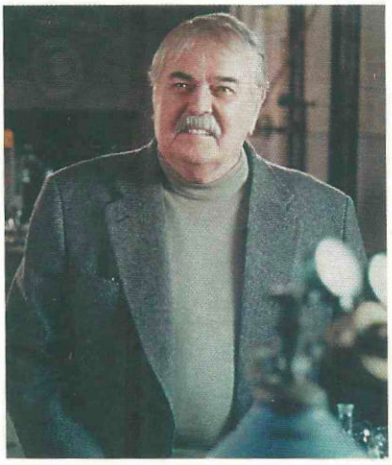

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